Abacus

Arcus

Hematology Analyzer

Service Manual

Rev. 2.4

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1. INTRODUCTION

Since **Abacus** and **Arcus** have so much common characteristics, we have decided to issue one Service Manual covering both instruments. Information herein applies for both instruments unless otherwise noted.

To be well up in the instruments, **please read this manual carefully** to have the knowledge for servicing the instruments perfectly and avoid extra costs and wasting precious time.

This **Abacus/Arcus Service Manual** contains the functional descriptions of both analyzers, the operation of the fluidic systems, the adjustments and settings and very important information for the Service Personnel about the service operations and possible problems.

1.1. Name and serial number

Name: **Abacus/Arcus** Hematology Analyzer
Serial No.: Every instrument has its own serial number, which is printed on the rear panel label and it can be read out from Device Information or from the Self test submenu. This identity number is write protected by DIATRON.

1.2. Intended use

Abacus/Arcus hematology analyzers are fully automated cell counters for *in vitro* diagnostic use. The compact instruments were developed for small to medium size labs.

Abacus can process 55, **Arcus** can process 35 samples per hour and they are intended to determine the following 18 hematology parameters from a 25 µl whole blood sample:

- WBC - LYM# - MID# - GRA# - LYM% - MID% - GRA% (three-part WBC differential)
- HGB - RBC - HCT - MCV - RDW - MCH - MCHC
- PLT - MPV - PCT - PDW

1.3. Integrated software

The integrated software controls the instrument operations, displays, stores, recalls data, and allows the User to perform QC and calibration procedures and modify the user settings. The software version number can be read out from the Device Information or from the Self test submenu.

Software (version V1.7 & higher) is absolutely *"Plug and Play"*, it can detect what type of instrument and what kind of parts (different dilutor and controller card types) are used and it will run the correct program for the hardware, without any user or service help. Every **Abacus/Arcus** software version is upgradable by the latest program developed by DIATRON, and it can be downloaded from:

www.diatronltd.com

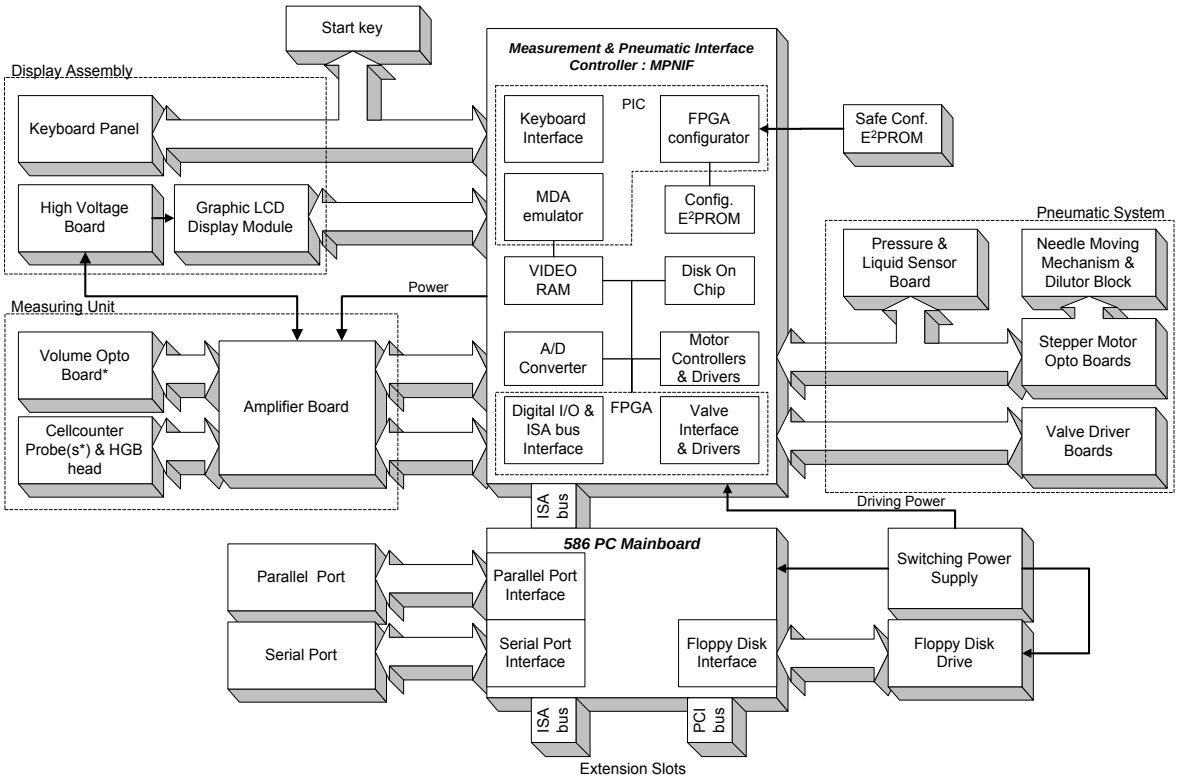
2. FUNCTIONAL DESCRIPTION

2.1. Main electronic parts of the analyzers

Abacus/Arcus Hematology Analyzers consist of the following electronic parts (see figure below):

1. Cellcounter Probe(s*****)
2. HGB Head
3. Volume Opto Board*****
4. Amplifier Board
5. Measurement & PNeumatic InterFace Card (MPNIF)
6. Safe configuration E^2PROM board
7. High Voltage Board
8. Graphic LCD Display Module
9. Keyboard Panel
10. Start key & glowing LED
11. Pressure & Liquid Sensor Board
12. Stepper Motor Opto Boards
13. Valve Driver Boards
14. Switching Power Supply
15. 586 PC Mainboard
16. Floppy Disk Drive
17. Parallel Port
18. Serial Port

***** Only for **Abacus**



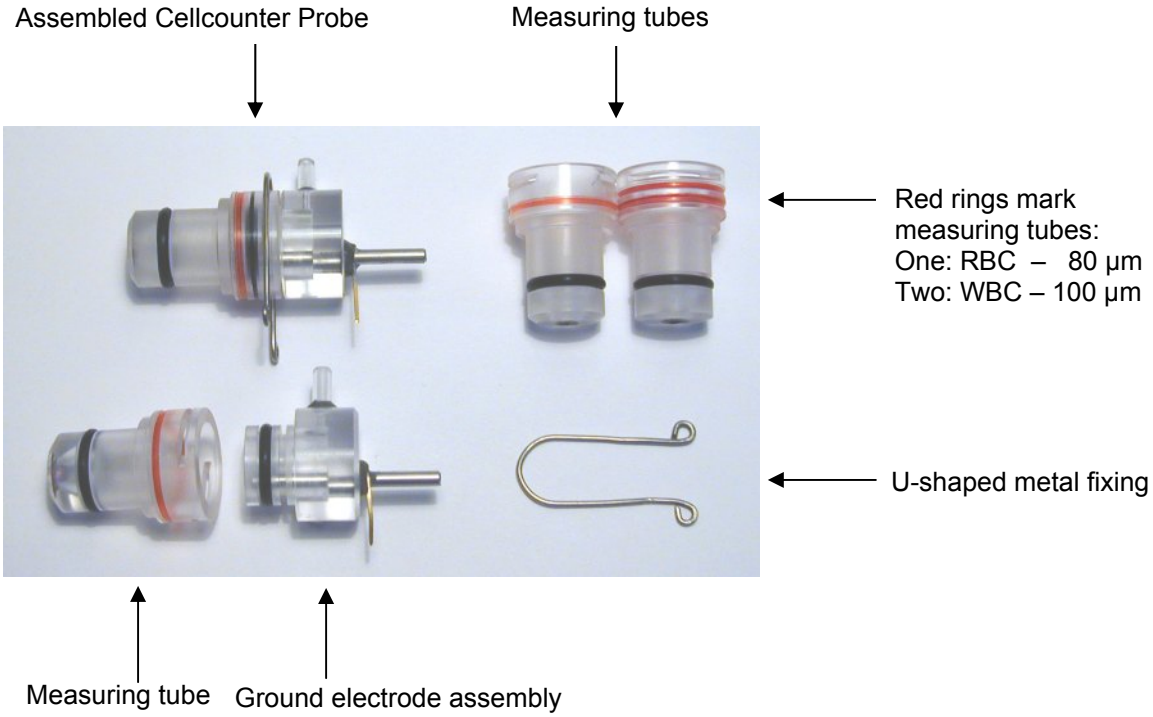
***Abacus/Arcus** Electronic Functional Block Diagram*

2.1.1. Cellcounter Probes

The impedance method is used for determination of volume and number of cells. In this method a known volume of dilution is drawn through a small aperture. Constant current is passed through the aperture from one side to the other. When a cell passes through the aperture, it causes a change in resistance, which generates a voltage pulse.

The amplitude of the voltage pulse is proportional to the ratio of cell volume per aperture volume. This is used to determine the volume of cells. The number of cells can be obtained by counting the pulses.

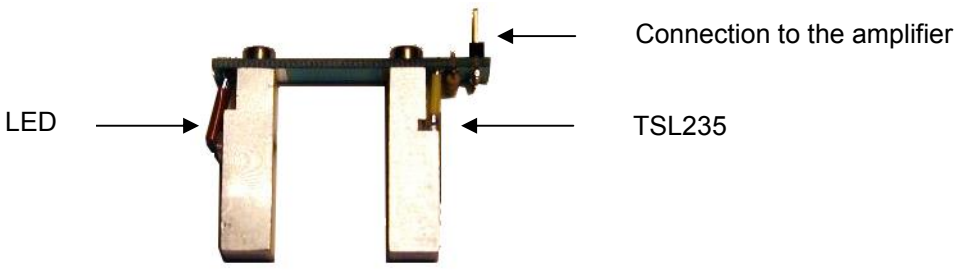
- In the **Abacus** there are two Cellcounter Probes: WBC probe with 100 µm aperture, and RBC probe with 80 µm aperture. Both have a ground electrode assembly and U-shaped metal fixing as it is shown in the next figure.
- In the **Arcus** there is only one Cellcounter Probe: the aperture size is 80 µm – this is the same as the RBC probe in the **Abacus**.



The aperture is made of ruby and it is glued into the measuring tube. The consistent fixing of glue is very important for measurements.

2.1.2. HGB Head

Hemoglobin head is placed at the bottom of the WBC chamber in the **Abacus,** and at the bottom of the measuring chamber in the **Arcus**. It contains: light source (LED) at 540 nm and Photo Detector (TSL235). The Photo Detector converts the light to frequency. The HGB concentration is a logarithmic function of this frequency measured by the FPGA circuit of the MPNIF card.



Abacus makes four kinds of HGB measurements (diluent measurements are performed on diluent reagent):

- Sample dark measurement (before WBC counting)
- Sample light measurement (before RBC counting)
- Diluent light measurement (in WBC washing phase)
- Diluent dark measurement (immediately after the previous one)

The HGB result is calculated from these measurements by:

$$HGB \cong \log [(CNT_{diluentlight} - CNT_{diluentdark}) / (CNT_{samplelight} - CNT_{sampledark})]$$

Arcus does not perform any dark measurements (it is always zero), so this equation is simpler:

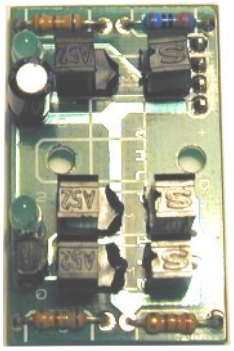
$$HGB \cong \log (CNT_{diluentlight} / CNT_{samplelight})$$

Do not open or close the instrument door during any measurement cycle, because this will cause error in HGB measurement. Normally, door should be closed during real measurements.

2.1.3. Volume Opto Board

This board is presented only in Abacus.

It contains three opto switches which make possible to measure a constant volume of the diluted sample with a special float. The volume opto board is connected to the amplifier board through the VM connector (on the other side of this board).



Measurement is made between OM1 and OM3 - no LED on, (OM2: gate opto is for bubble error prevention).

The upper LED is lit, when the float is between the OM1 sensor.

The lower LED is lit, when the float is between the OM2 sensor, but OM3 sensor is not

2.1.4. Amplifier Boards

Abacus and Arcus amplifier boards are different PCBs, but there is a lot of common functional parts on them.

- **Common** functional parts: amplifier board includes its own voltage regulator, the connection interfaces for HGB head, for high voltage board and for MPNIF card.

  In this board there is the current generator circuit, which works from 50 V measuring voltage (coming from high voltage board) and the probe (DC) voltage is amplified with a voltage follower (output: ELV). Nominal measuring current is **870 µA**.

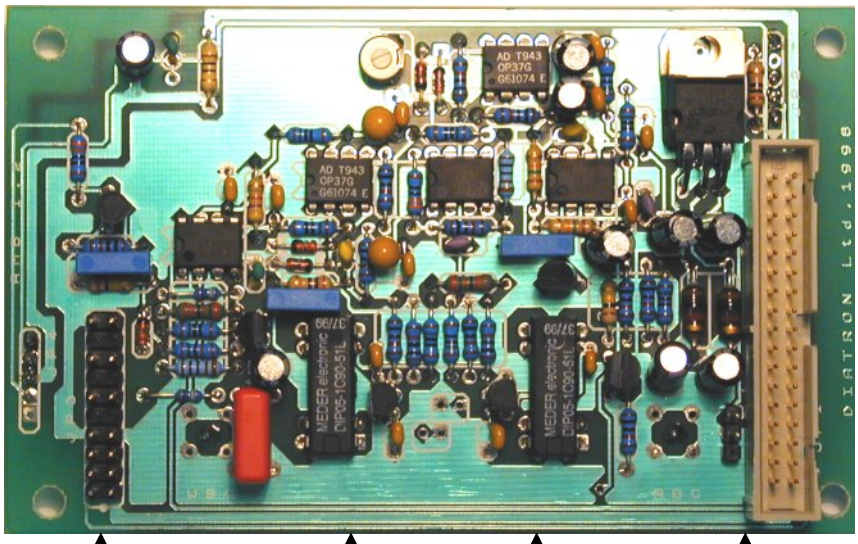
  The amplifier board includes the main 3-stage amplifier channel, which amplifies the input signal to the 0...5 V range (this is the input range of the A/D converter, which is on the MPNIF card). The offset voltage is set by P1 potentiometer by the manufacturer, **never adjust it**.

  The test circuit makes possible to generate test pulses (with TEST and PLS signals through FETs) for checking the proper operation of the amplifier channel.

- **Abacus amplifier** board includes also the connection (JP2) for volume opto limiter.

  In this board there are two reed relays on the input side: IC10 can select between the two channels (RBC, WBC) with RSW signal; IC11 connects high voltage (from high voltage board) to the selected probe with HSW signal.

  The DHON signal (from the MPNIF card) switches on the LED in the HGB head via a transistor (Q3), but the Photo Detector in the HGB head is working continuously.

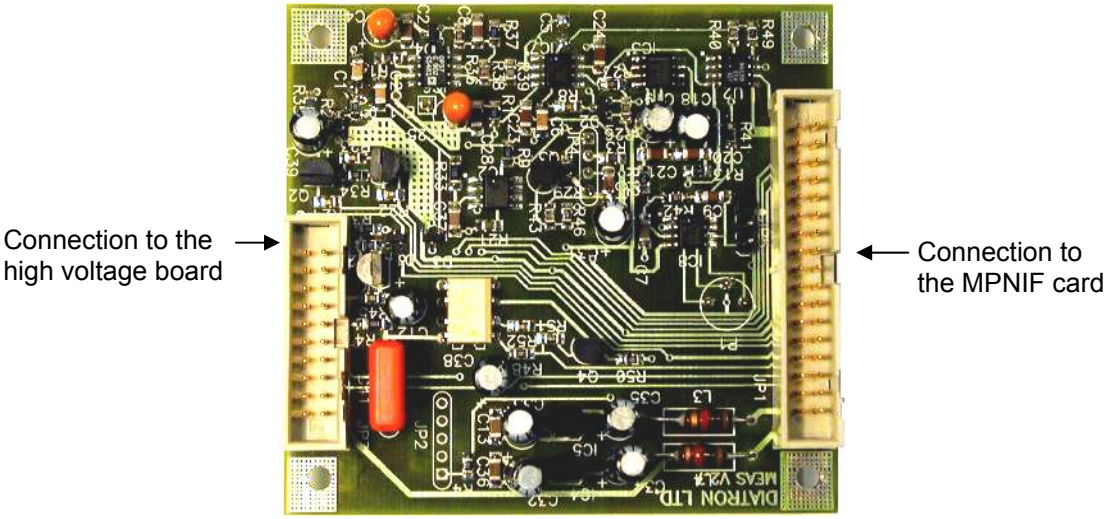


- **Arcus amplifier** board includes only one input connector for the chamber.

  In this board there is no relay in the input stage, but there are two opto switches (U1, U3: TLP627) to connect high voltage (from high voltage board) to the probe with HSW signal and isolate the input of the amplifier.

  The RSW signal changes the gain (RBC, WBC) in the feed back of the second amplifier stage with U2 (MAX319) analog switch.

  The DHON signal (from the MPNIF card) switches on the LED and also the Photo Detector in the HGB head via a transistor (Q3) that is why there is no dark HGB value in **Arcus**.



The other side of the amplifier boards includes special connectors for the chamber(s) and connector for the HGB head (JP4).

2.1.5. Measurement & Pneumatic Interface Card (MPNIF)

The new **MPNIF** card incorporates the measurement processing (the earlier MPU card), and also the pneumatic, display and keyboard (the earlier PNIF card) functions in one board.

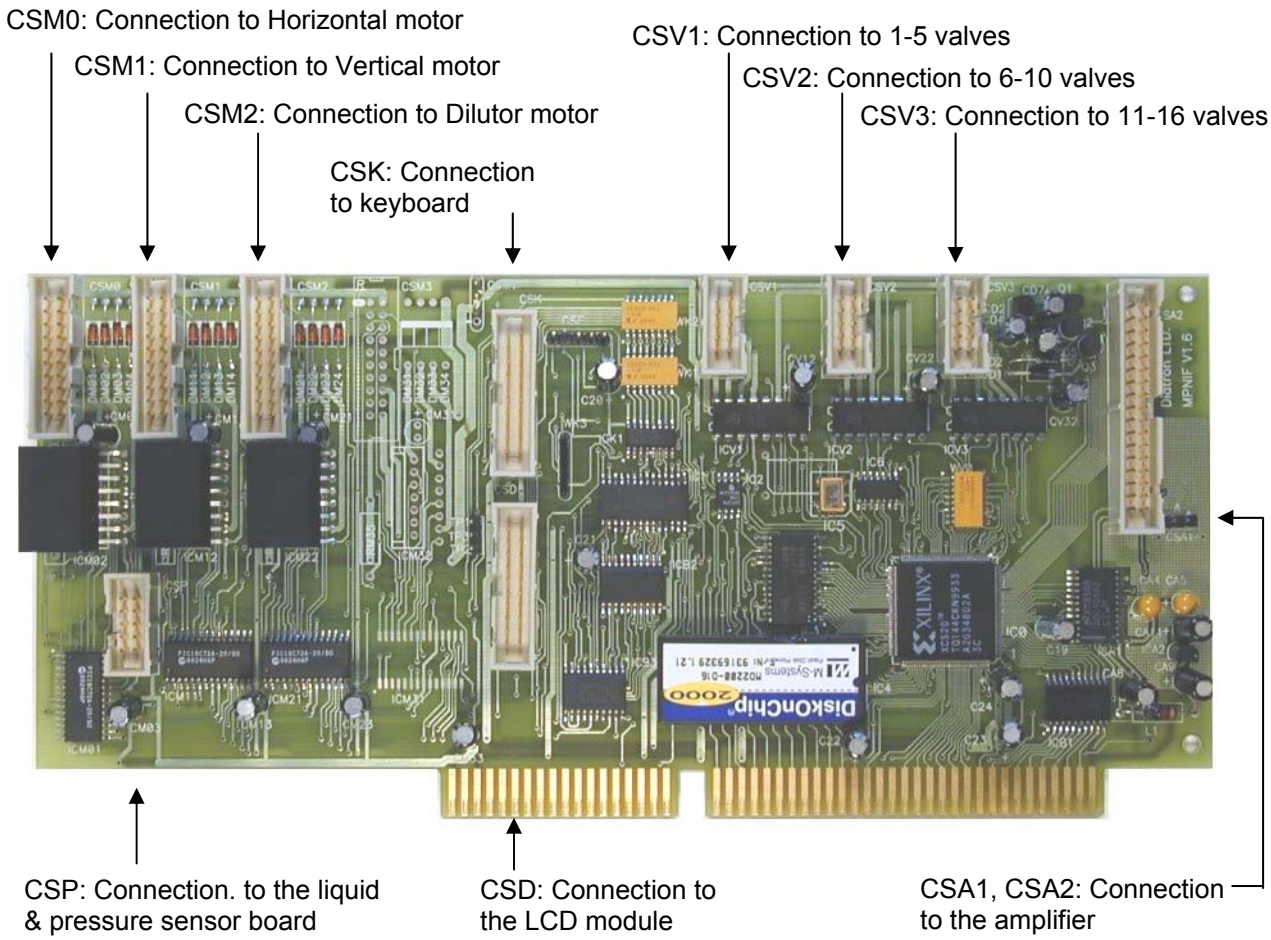
Furthermore, this card contains a DiskOnChip circuit, which substitutes the earlier hard disk module, with the same storage capacity (10.000 samples in the **Abacus**, and 2.000 in the **Arcus**). In addition, this card has an MDA (monochrome display adapter) emulation mode, which allows the Service Person to use the LCD like a computer monitor without any plus cards (VGA) for checking the proper operation of the instrument's mainboard.

The controller card is connected to the PC mainboard through the ISA bus. After power on the card holds the mainboard in wait state (with -IOCHRDY signal) until the **PIC** configures the FPGA circuit from the configuration E^2PROM or from the safe E^2PROM. After that the **FPGA** makes the I/O and memory address decoding and selects the actual part placed on the board:

- DiskOnChip (16 Mbytes for **Abacus**, 8 Mbytes for **Arcus**)
- Video RAM for MDA (Monochrome Display Adapter) emulation
- Card controller PIC
- Motor controller PICs

The FPGA circuit also performs the main measurement data sampling and communication tasks. The board's A/D chip with its own sample/hold circuit makes the analog to digital conversion. After that the FPGA makes the data processing and stores the results in the temporary FIFO memory. The results are sent to the PC mainboard by DMA cycles.

With the internal registers of the FPGA the software can control the valves, the digital interface of the amplifier and the controller PIC. This circuit (PIC) is also responsible for displaying and keyboard scanning, after the configuration.


CSM0: Connection to Horizontal motor
CSM1: Connection to Vertical motor
CSM2: Connection to Dilutor motor
CSK: Connection to keyboard
CSV1: Connection to 1-5 valves
CSV2: Connection to 6-10 valves
CSV3: Connection to 11-16 valves
CSP: Connection. to the liquid & pressure sensor board
CSD: Connection to the LCD module
CSA1, CSA2: Connection to the amplifier

2.1.6. Safe configuration E^{2}PROM board (IDEPROM)

This board contains a 24FC256 serial E^{2}PROM, which stores the FPGA's configuration data, Safe greeting screen and identity information about the instrument. In the new version there is no hard disk and all information is stored in the DiskOnChip of the MPNIF card. This card is the same for both instrument types (**Abacus, Arcus**), except for the DiskOnChip size. Keeping the hardware identity information, the IDEPROM makes possible to run the correct software (Abacus or Arcus) and store the instrument's serial number.

The IDEPROM is connected to the MPNIF card and it is write protected.

The data of the normal configuration E^{2}PROM on the MPNIF card can be modified by the software, allowing change the FPGA functions. If there is any problem (e.g. power off) during this overwriting process, the instrument will start in "Safe mode" (this is displayed on the LCD) and the FPGA will be configured from the Safe E^{2}PROM (IDEPROM card).

2.1.7. High Voltage Board

High Voltage Board generates the LCD backlight voltage, the aperture cleaning voltage (150V), and the measuring voltage (50V). The high voltage board is connected to the system through the amplifier board and the MPNIF card.

This unit contains INVC191 inverter, which is a high voltage, high frequency circuit producing suitable voltage for CCFL (cold cathode fluorescence lamp) of the LCD.

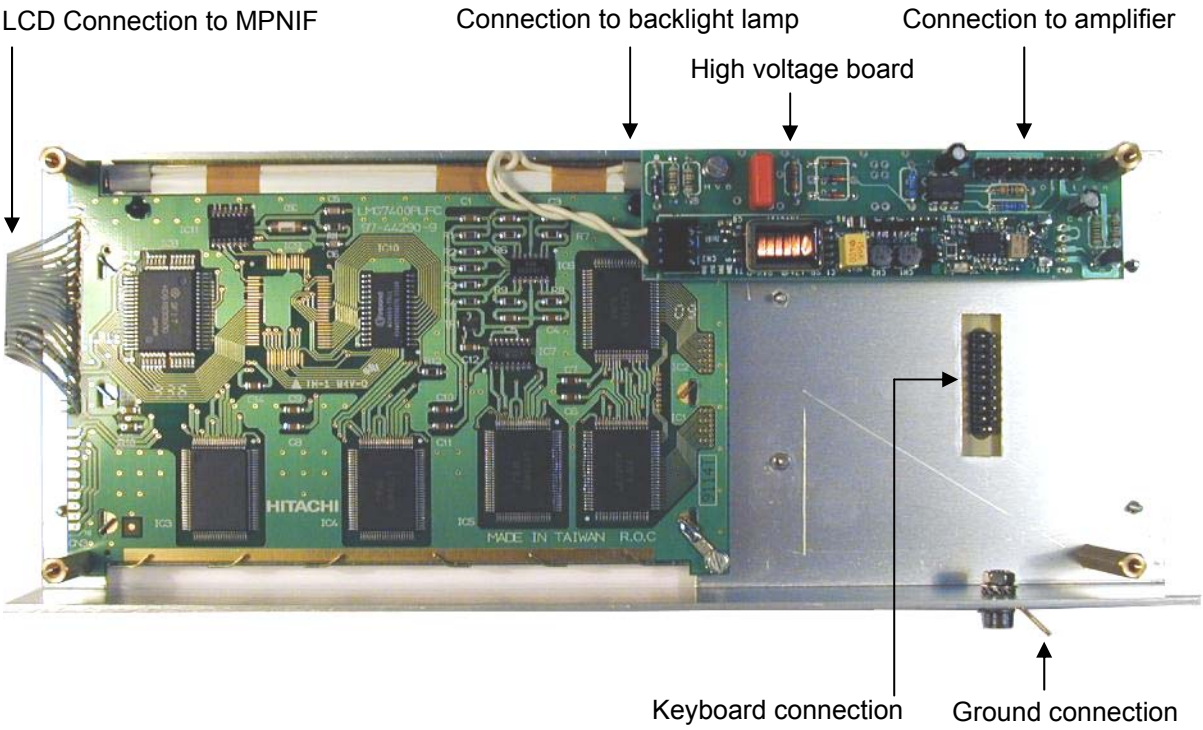
The CFSW digital signal (from the MPNIF card) controls the high voltage board, if it is high (1) the inverter is off, if it is low (0) the inverter is on.

The MVON digital signal (from the MPNIF card) switches the measuring voltage (50 V) on/off by O1 opto switch.

> ***Warning! Be careful with servicing this board in active state, because the high voltage can make damages or electric shock!***

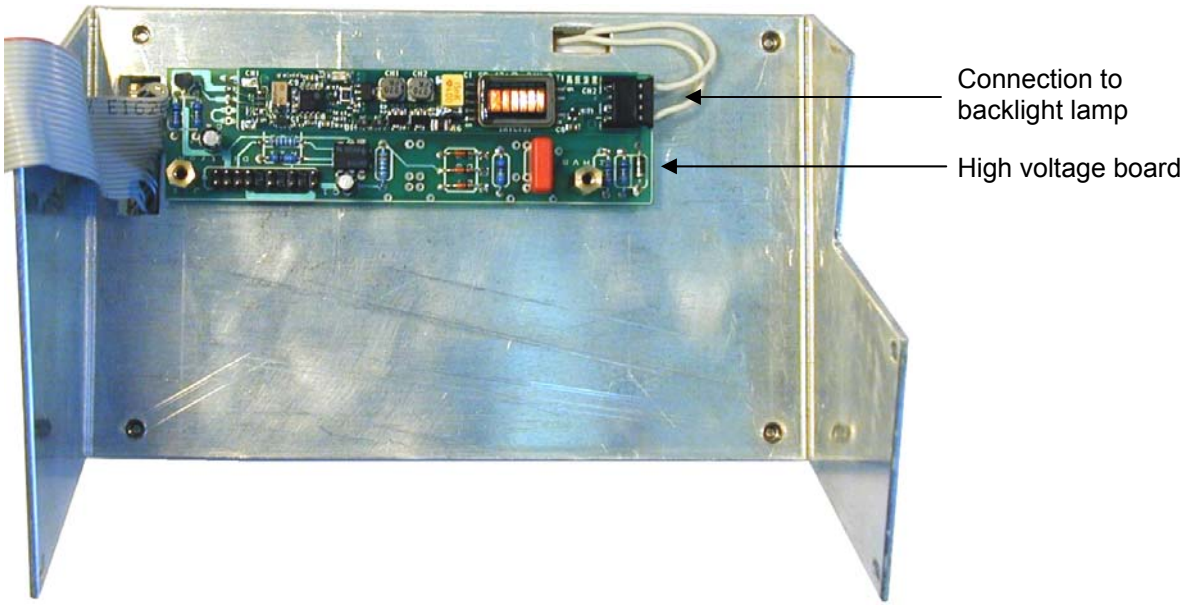
2.1.8. Graphic LCD Display Module

This module contains 240x128 dots LCD display (HITACHI LMG7400PLFC), the high voltage board and this is the back panel of the keyboard module. LCD has a high voltage backlight lamp (the high voltage board generates the required voltage).



The picture above shows the opened LCD module of an **Abacus**.

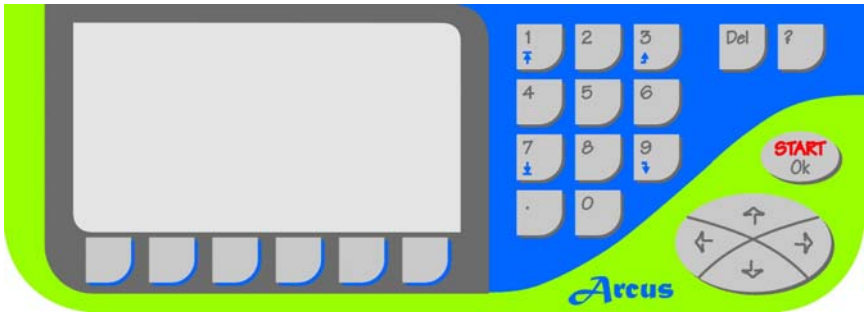
In the **Arcus** the high voltage board is assembled over the LCD display:



In the LCD module and in the MPNIF card there is a special temperature compensation circuit, which makes possible to use the LCD module in wide temperature ranges with the adjusted contrast.

2.1.9. Keyboard Panel

The analyzer has a 24-button foil keyboard including numerical keypad (0...9, .), cursor moving and OK buttons, Delete and Help (?) keys and 6 function buttons, under the LCD display as it is shown in the figure below (**Arcus** keyboard panel):



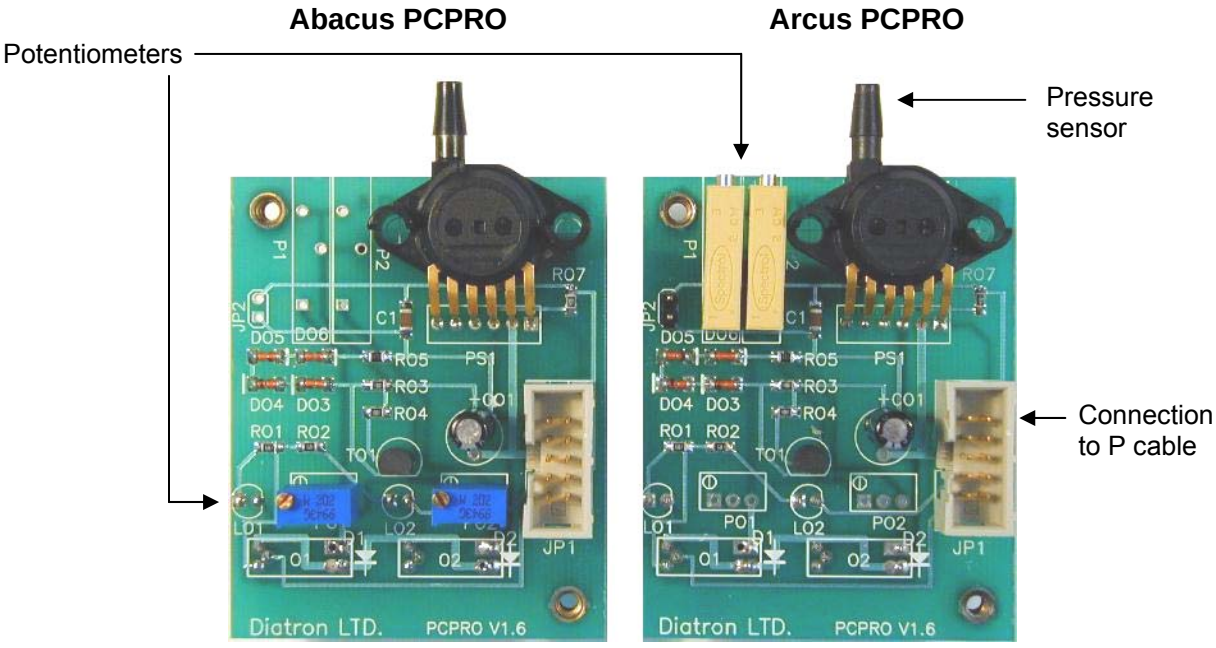
2.1.10. Start key & glowing LED

The Start key is a micro switch, connected to the MPNIF card (through the K&L ribbon cable). The glowing LED indicates the actual status of the analyzer and it has three colors: red, green and amber (See User's Manual). The LED has three pins and the actual color depends on the controlled pins. The LED is also connected to the MPNIF card through the K&L ribbon cable.

2.1.11. Pressure & Liquid Sensor Board (PCPRO)

This board contains MPX5100AP calibrated pressure sensor, which can measure the required air pressure and vacuum. The board also contains two liquid detectors that can check the existence of the diluent and lyse reagents.

In the PCPRO board there are two potentiometers to adjust the sensitivity of both liquid sensors, but the orientation of these potentiometers are different for **Abacus** and **Arcus** for easier adjustment (see the pictures below). The left potentiometer is for the Diluent detector sensitivity and the right is for the Lyse detector sensitivity. There are also special temperature compensation parts, which make possible to use the liquid sensors in wide temperature ranges with the adjusted sensitivity. The liquid detectors use common opto switches for detecting the reagents. The PCPRO board is connected to the MPNIF card through the P ribbon cable.



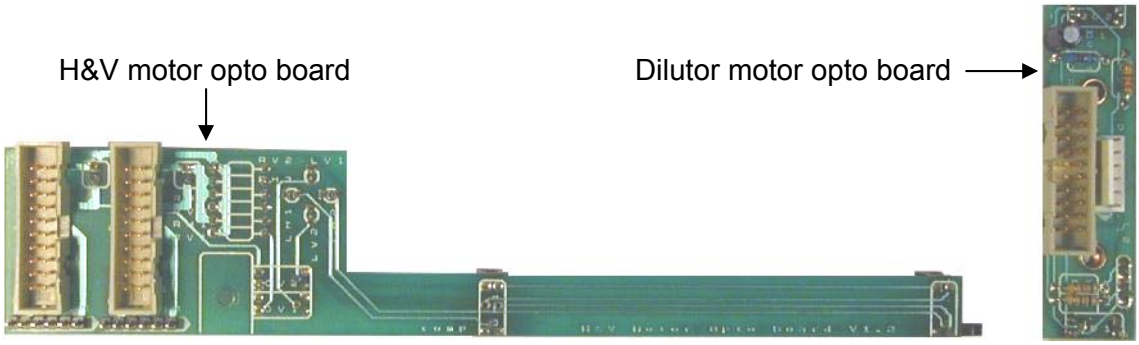
On the other side of the board there are the two opto switches (liquid detectors) and both of them have an indicator LED which show the actual status of the sensors. The LED is on if no reagent in the tube.

> ***The pressure sensor tolerates maximum +5 V and it has the same V_{cc} as the optos have. Do not connect higher voltage than +5 V to this board because it can ruin the pressure sensor.***

2.1.12. Stepper Motor Opto Boards

There are three stepper motors in the system: Horizontal and Vertical motors, which make the movements of the aspirating tip, and Dilutor motor, which moves the three syringes (macro, lyse, micro). The stepper motor opto boards make the connections between the controller PICs (AHAPICs) and motors, and have opto switches for the motor's end and home positions. The actual status of the stepper motor's optos is indicated by two LEDs on both stepper motor opto boards.

H&V motor opto board connects to the horizontal and vertical stepper motors and to the MPNIF card (through HM and VM ribbon cables). On the other side of this board, there are four opto switches of the two stepper motor positions (home and end for both) and its own indicator LEDs.



Dilutor motor opto board contains the opto switches of the dilutor motor, which moves the syringes in the fluidic system and the connection between the motor and the DM ribbon cable (from the MPNIF card). On the other side of the board there are two opto switches (home and end switches) and their own indicator LEDs.

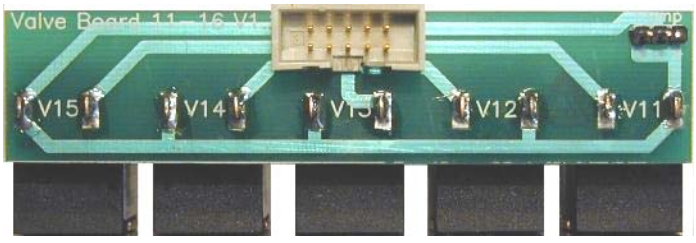
2.1.13. Valve Driver Boards

In the **Abacus** there are three kinds of different valve driver boards:

- Valve board 1-5
- Valve board 6-10
- Valve board 11-15 & pump

In the **Arcus** there are only two kinds of valve driver boards:

- Valve board 1-5
- Valve board 11-15 & pump



The Valve 11-15 driver board contains the MO connection to the Pump unit.

The valve driver boards are connected to controller chips located on the MPNIF card through A, B and C ribbon cables. (In the **Arcus** there is no B cable). These boards control the valves in 5-valve sets.

2.1.14. Switching Power Supply

The analyzer works with a standard PC switching power supply. The power supply has its own internal fuse and a built in fan. The most frequent problem is the malfunction of the fan. The power supply has a temperature sensor, which can detect this problem and shut down the power.

2.1.15. 586 PC Mainboard

The analyzer works with a common 586 PC Mainboard with an Intel Pentium™ processor or compatible and with a minimum of 16MB SD RAM module. The settings of the mainboard depend on the manufacturer. The required settings of this mainboard and the BIOS setup values are enclosed in the Main Board Manual. The mainboard includes a **CMOS battery** that allows storing the BIOS settings during power down.

> ***CAUTION: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the battery manufacturer. Dispose of used batteries according to the manufacturer's instructions.***

2.1.16. Floppy Disk Drive

The built in Floppy Disk Drive makes possible to save data on floppy disks, and to install (or upgrade) the software. The system's boot sequence is A: then C: so the system can start from a system disk or can make software installation or upgrade with a special Software Installation/Upgrade disk (it is not a standard floppy disk) if you start the analyzer from this disk. Floppy disk drive is placed in a special mounting in the bottom of the instrument.

2.1.17. Parallel Port

The parallel port located on the rear panel (LPT1) is for the external printer. The printer must be compatible with HPGL in case of SW version < 1.3. The SW version 1.3 and newer ones are compatible with HPGL, Epson Esc P and Esc P2 protocols.

2.1.18. Serial Port

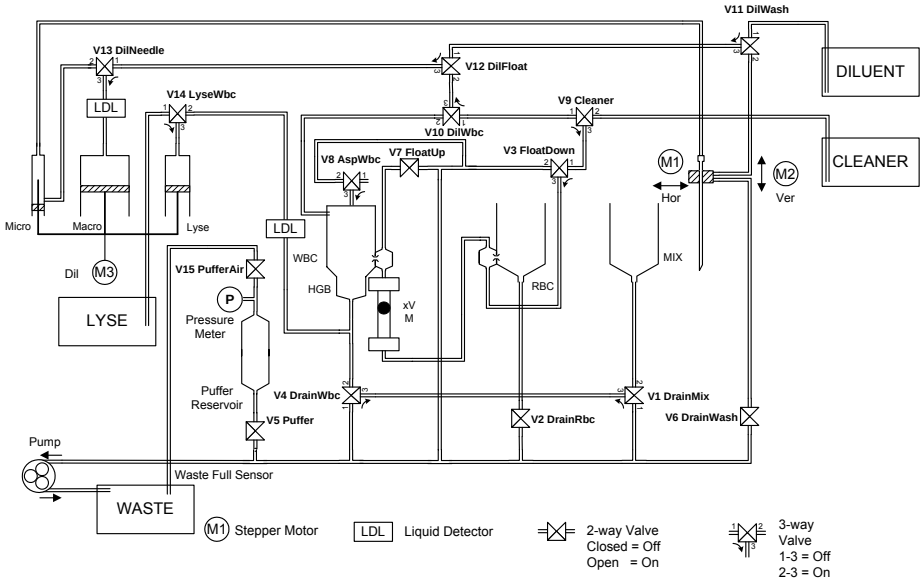
The Serial port is a standard RS 232 V24 port with the standard pin-out. This port is useful for communication with a host computer.

2.2. Main mechanic and fluidic parts of the Analyzer

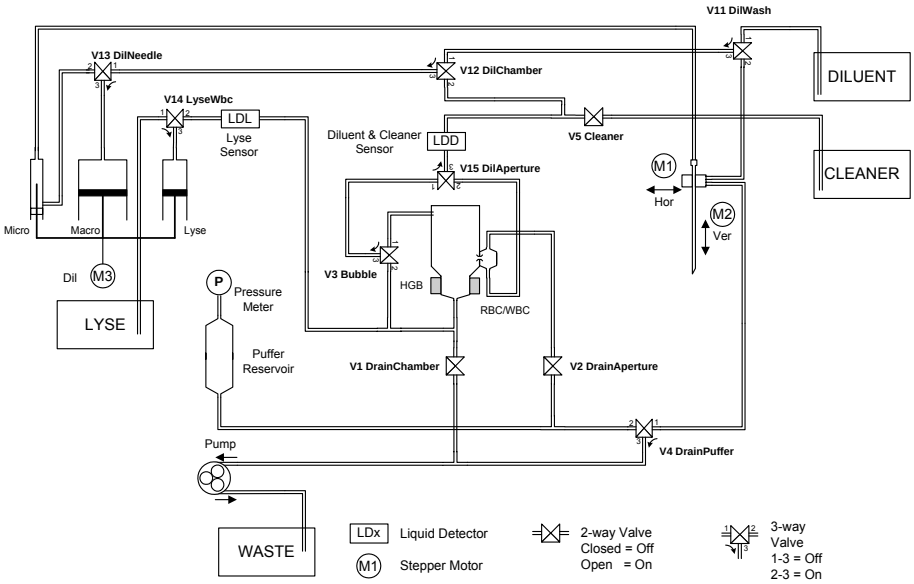
Abacus/Arcus Hematology Analyzers consist of the following mechanic and fluidic parts:

1. Dilutor
2. H&V moving unit
3. Volume meter tube (xVM)*
4. Pump
5. Aspirating tip
6. Chamber(s*****)
7. Valves (1-5, 6-10*****, 11-15)
8. Washing head
9. Puffer reservoir
10. Tubing

***** Only for **Abacus**



***Abacus** Fluidic Schematics*



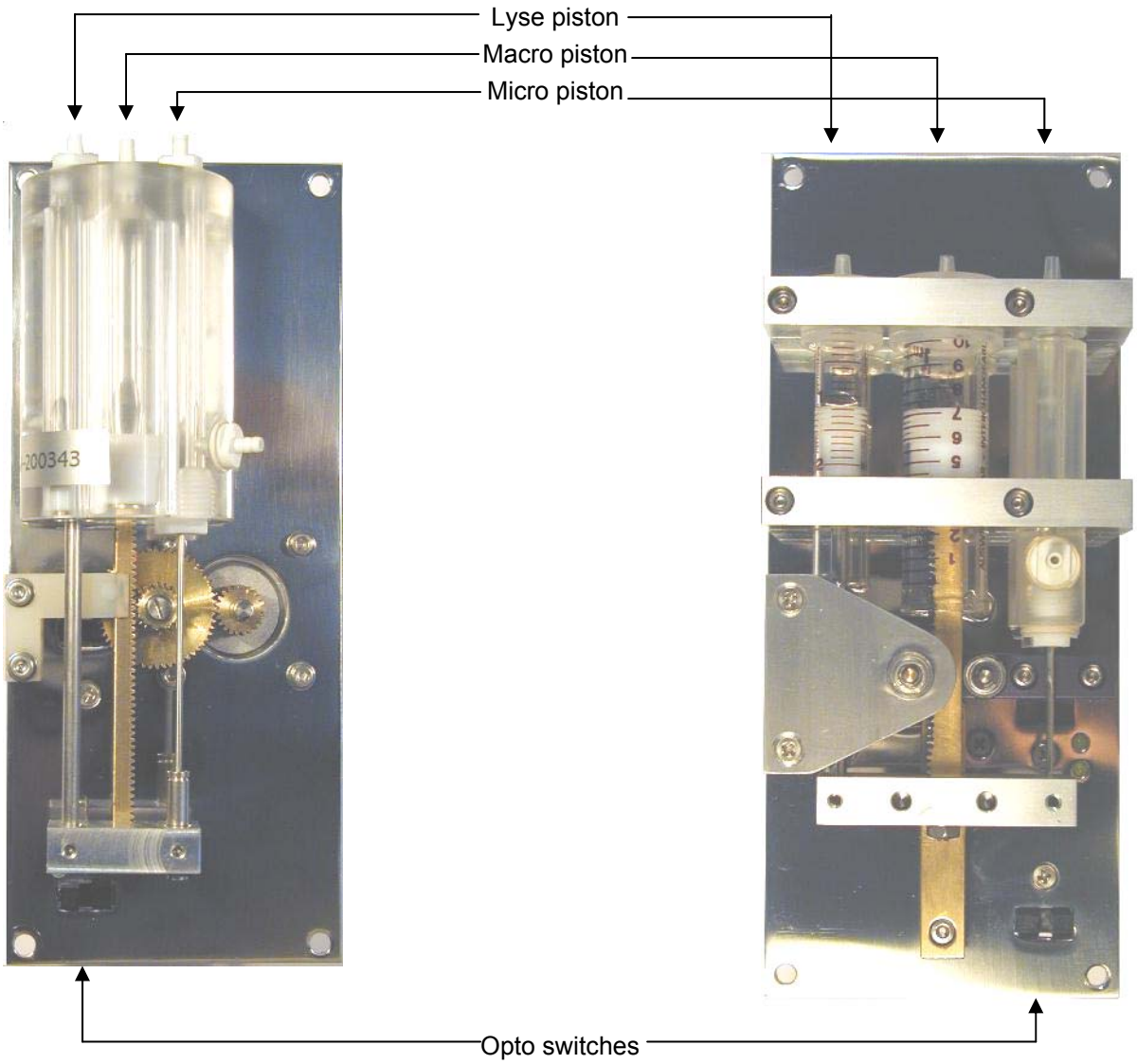
***Arcus** Fluidic Schematics*

2.2.1. Dilutor

This unit is the same for both instruments (**Abacus** and **Arcus**) and includes the dilutor stepper motor, the dilutor motor opto board, three syringes and the piston rods with special transmission. The dilutor motor opto board is on the other side of this unit.

- The picture on the left shows the earlier **Abacus** dilutor module made of plexiglass.
- The right picture shows the new **Abacus/Arcus** dilutor module with the three separated syringes.

Earlier Abacus dilutor module **The New Abacus/Arcus dilutor**



Both types of dilutors work with the same stepper motor and stepper motor board (the SW from 1.7 can drive both types). Both have home & end position opto switches. Macro syringe is for diluent reagent, Lyse syringe is for lyse reagent. The Micro syringe is for the precision sampling.

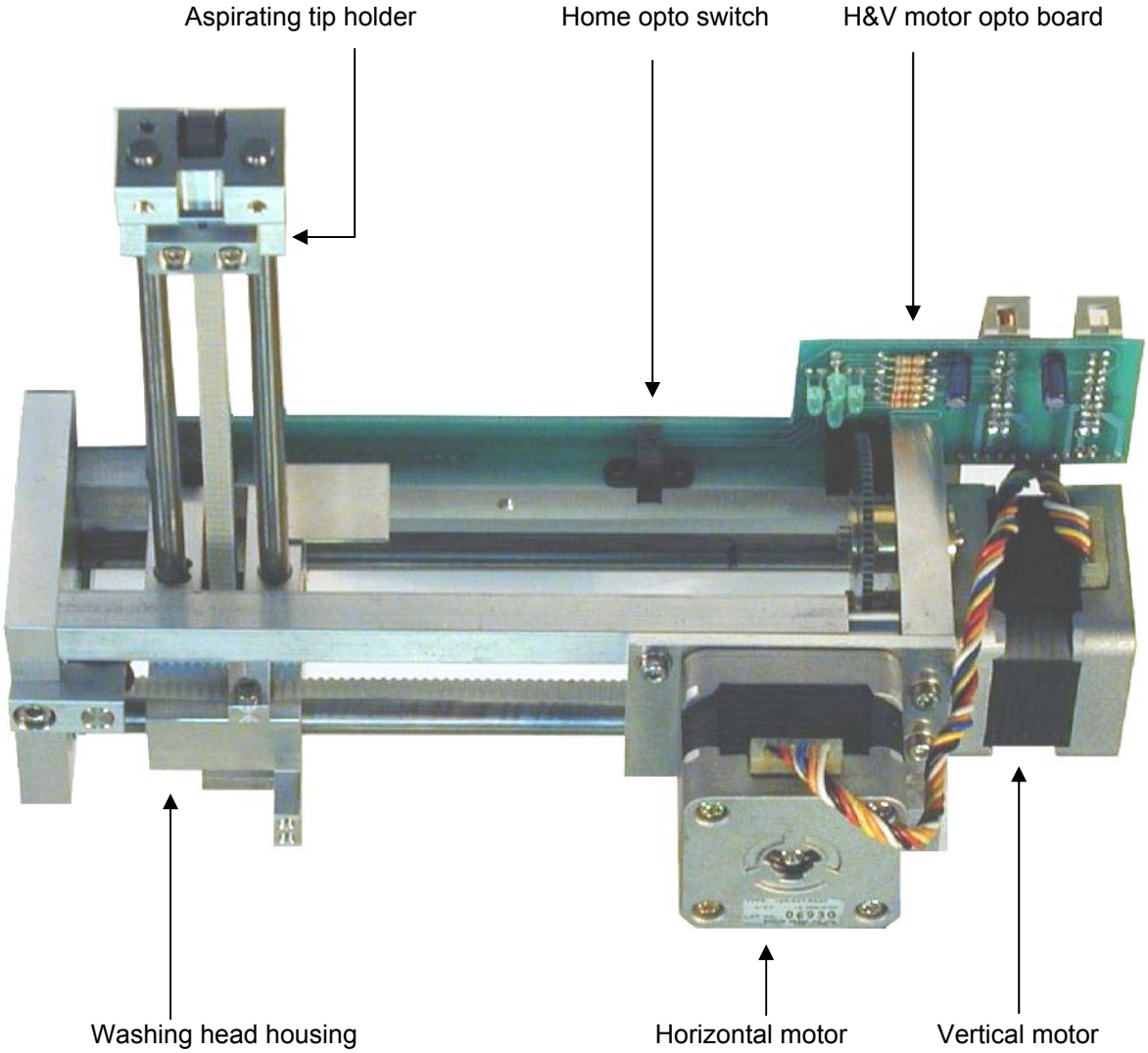
The earlier **Abacus** dilutor module's piston house is made of one piece of plexiglass and it has a plastic, L-shaped gear bar support.

The new **Abacus/Arcus** dilutor module works with separated syringes (glass for Macro and Lyse; plexiglass for Micro). The transmission is different than in the earlier module and the new dilutor works with bearings and motor rod support.

2.2.2. H&V moving unit

This unit is the same for both instruments (**Abacus** and **Arcus**) and it contains the Horizontal and Vertical stepper motors, H&V motor opto board, opto wheel and the special mounting.

This moving unit moves the aspirating tip and in the assembled analyzer it includes the aspirating tip and the washing head.



The Vertical motor works with a special opto wheel for detecting home & end positions. See the adjustment section of this manual to place this wheel to the proper position.

2.2.3. Volume meter tube (xVM)*

The volume meter tube (xVM) is mounted on the volume opto board (see photo).

The tube contains a float, which is moved up by diluent flow before counting. During counting, first it comes down, the measurement is started when the top LED goes off, and the movement of the float is proportional to the volume of WBC dilution measured. Counting stops when bottom LED goes on. RBC counting is performed when the float goes upwards (none of the LEDs are on).

The arrow on the tube must point upwards when replacing tube.

Do not mix up the float direction during cleaning of the float, because the chamfering is not symmetrical.

The long, small angle chamfer must face to the bottom of the tube.

2.2.4. Pump

The pump generates the regulated vacuum and drains the fluidic system. The pump is connected to the Valve 11-15 driver board (MO connection) and the control chip located on the MPNIF card drives this unit.
Two, **different** type of **peristaltic pumps** are used in the Abacus/Arcus instruments:

- The **earlier peristaltic pump** model. This is a very simple, easy to service model, but it needs some weekly maintenance for longer lifetime (see Maintenance section of this manual).

  The only spare part, which is included in the instrument pack, is the head of this pump (see the picture).

- The **new peristaltic pump** model. This is a more reliable, more complicated model with bigger size. For servicing the tube of the pump, open the peristaltic pump casette from its top (see picture) and remove the tube together with the white plastic side wall (see picture):

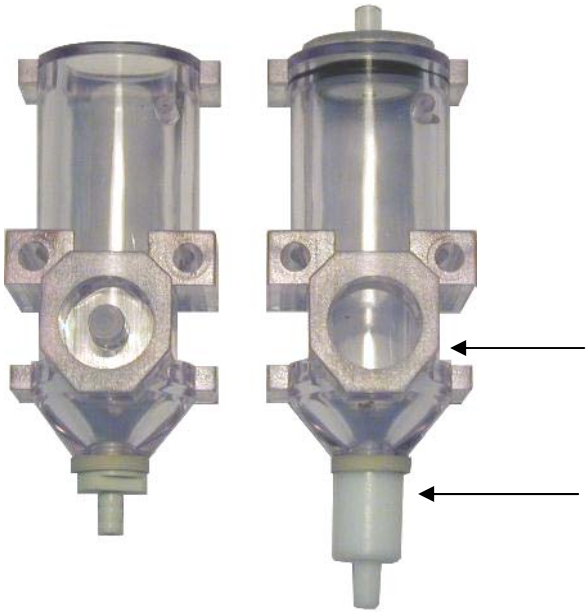
In case of damaged tubes, it can be replaced by a new one by opening the two metal lock located at both ends of the tube (see picture).

2.2.5. Aspirating tip

The aspirating tip is assembled in the H&V moving unit and it makes the sample aspirations. The right setting of the aspirating tip is necessary and very important (see adjustment).

2.2.6. Chamber(s*)

- In the **Abacus** there are three different chambers made of plexiglass. The MIX chamber is for the first sample diluting. The RBC and the WBC chambers are mounted with the cell counter probes.



The chamber on the left is an **Abacus** MIX chamber, it is closed from the front and it is opened at the top.

The chamber on the right is an **Abacus** WBC chamber with the hole in the front for the cellcounter probe. It is closed at the top and it has the special WBC long teflon draining connector.

Place for cellcounter probe

Long teflon draining connector

- In the **Arcus** there is only one chamber for diluting and measuring the blood cells. This chamber is the same as the WBC chamber in the **Abacus** with the long teflon draining connector but it is opened at the top (without cap).

It is extremely important for both instruments that these chambers should have no damage or crack because it could cause erroneous measurements (noise).

2.2.7. Valves (1-5, 6-10*, 11-15)

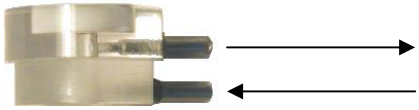
There are two kind of pneumatic valves in the system:

- 2-way Valve
- 3-way Valve

The valves are assembled by five on the valve driver boards. **Abacus** contains three of these boards (15 valves); **Arcus** has only two of them (10 valves).

2.2.8. Washing head

Washing head is located at the bottom of the H&V moving unit and it is for cleaning the outer surface of the aspirating tip. This washing process is made by diluent reagent and the fluid is drained by the pump. The arrows on the picture show the direction of diluent flow.



Draining by the pump

Diluent reagent

2.2.9. Puffer reservoir

The puffer reservoir insures the stable vacuum during the measuring process. **Abacus** and **Arcus** puffer reservoirs are made by glass but in different sizes. The figures of these units are shown on the assembled analyzers section of this manual.

2.2.10.Tubes

The fluidic system contains tubes, which have different diameters and lengths and also made by different materials. The earlier instruments use only silicon tubes but in the new systems the tubes that are holding liquid are replaced with bi-layer polyethylene ones.

The Tubing Schematics contains the parameters of the tubes (length & diameter).

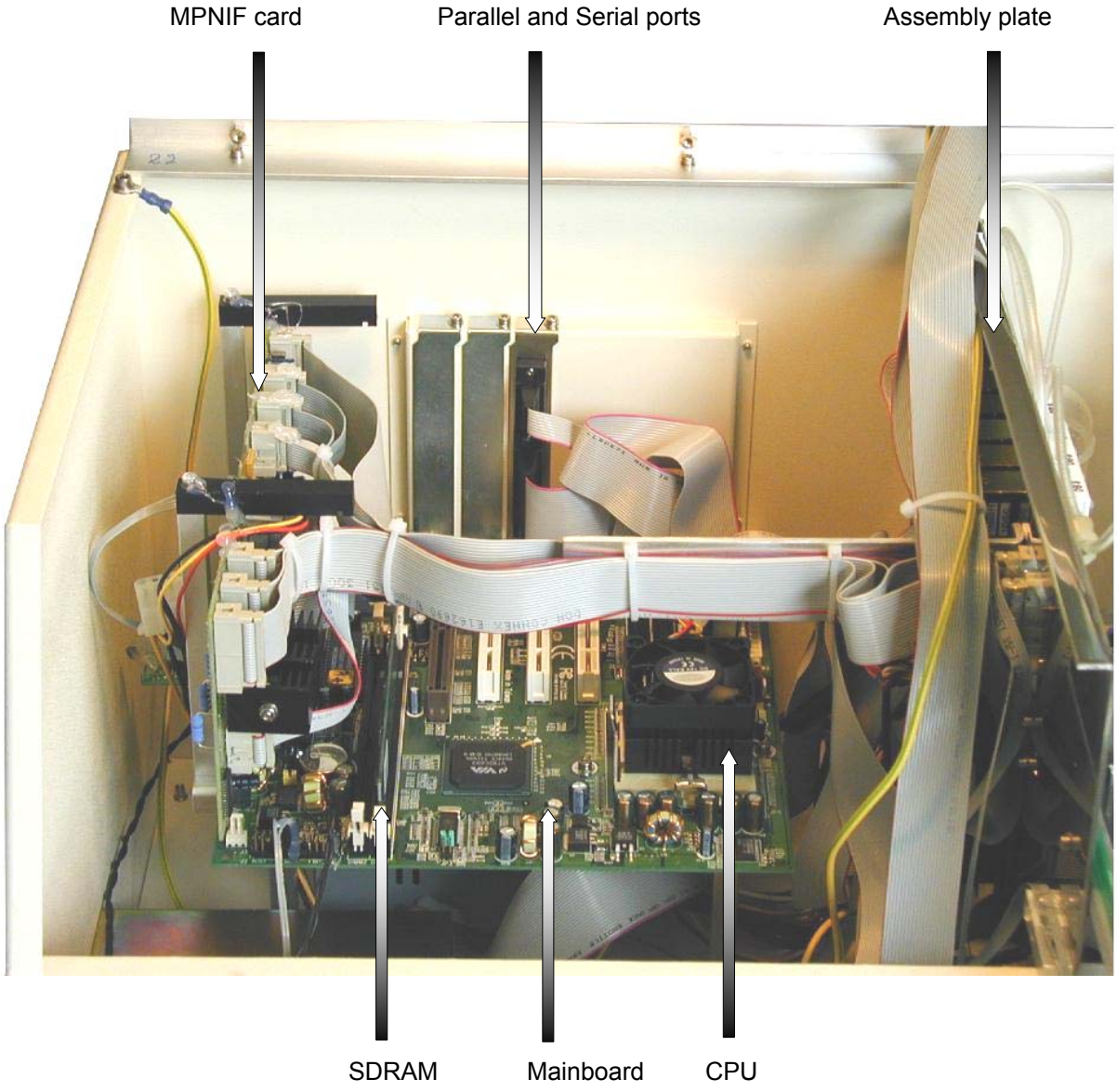
2.3. Assembled Analyzers

This section includes the photos of the assembled analyzers. There are two main parts for both instruments:

- The electronic block located on the left side
- The mechanic and fluidic block located on the right side and it is assembled to the stainless steal assembly plate, which makes also the separation from the electronic block

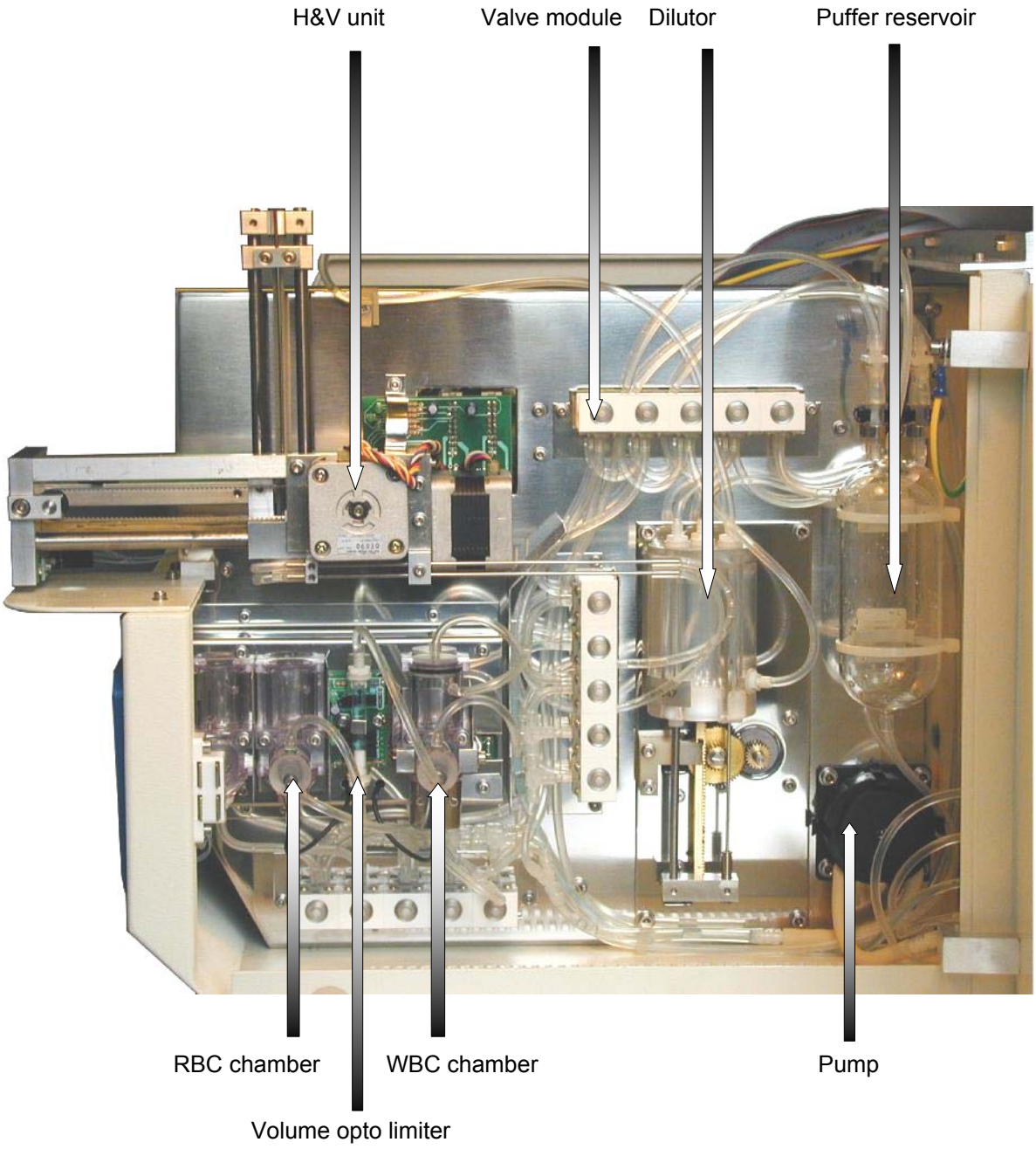
2.3.1. Abacus electronic block

This block contains the main electronic parts (see 2.1) of **Abacus**, the cables and the mainboard holder plate.



2.3.2. Abacus mechanic and fluidic block

This block includes the mechanic and fluidic parts (see 2.2) of **Abacus** and it is located on the assembly plate. The analyzer has a door (with magnetic lock) on the right side, which makes easy to access the mechanic and fluidic system.

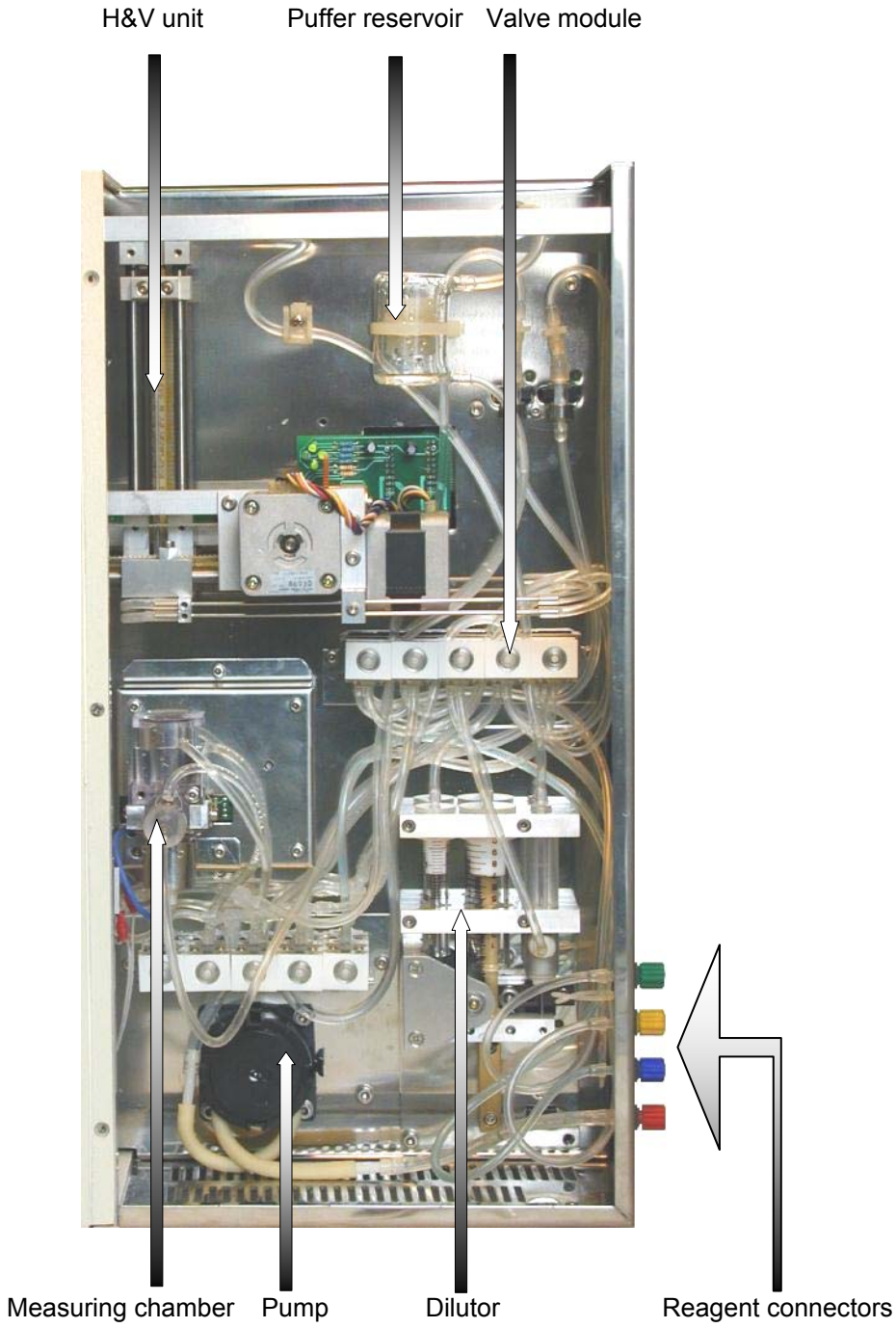


2.3.3. Arcus electronic block

This block contains the main electronic parts (see 2.1) of **Arcus**, the cables and the mainboard holder, a rack system plate.

2.3.4. Arcus mechanic and fluidic block

This block includes the mechanic and fluidic parts (see 2.2) of **Arcus** and it is located on the assembly plate. The analyzer has a door (with magnetic lock) on the right side, which makes easy to access the mechanic and fluidic system.



3. OPERATION OF THE FLUIDIC SYSTEM

This section describes the main fluidic steps of **Abacus** and **Arcus** measurement cycle. The fluidic systems are totally different in the two instrument types but they use the same modules (valves, tubes, chambers,…) and from the point of the measurements they follow the same steps. For this reason we decided to show the fluidic system processes for both instruments in the same logical blocks.

The **Abacus** and **Arcus** Fluidic Schematics are shown in 2.2. section of this manual. The following figures show the actual process and help to understand the fluidic system work.

The following steps are introduced in this section:

1. Sampling process
2. Aspirating tip washing process
3. Diluting process
4. Lysing process
5. WBC counting process
6. RBC counting process
7. Washing processes
8. Cleaning process

The active pipe is filled with black color, beside the pipe an arrow (→) shows the direction of the flow. The moving mechanic parts have a bigger arrow (⇧) which shows the direction of the movement. Only the opened (On) valves are mentioned in this section while all the other valves are closed (Off).

There is a special pneumatic process in the **Abacus**, which must be mentioned in this section, it is simple enough so that no figure is necessary for understanding. This is the **Waste Full Checking process**:

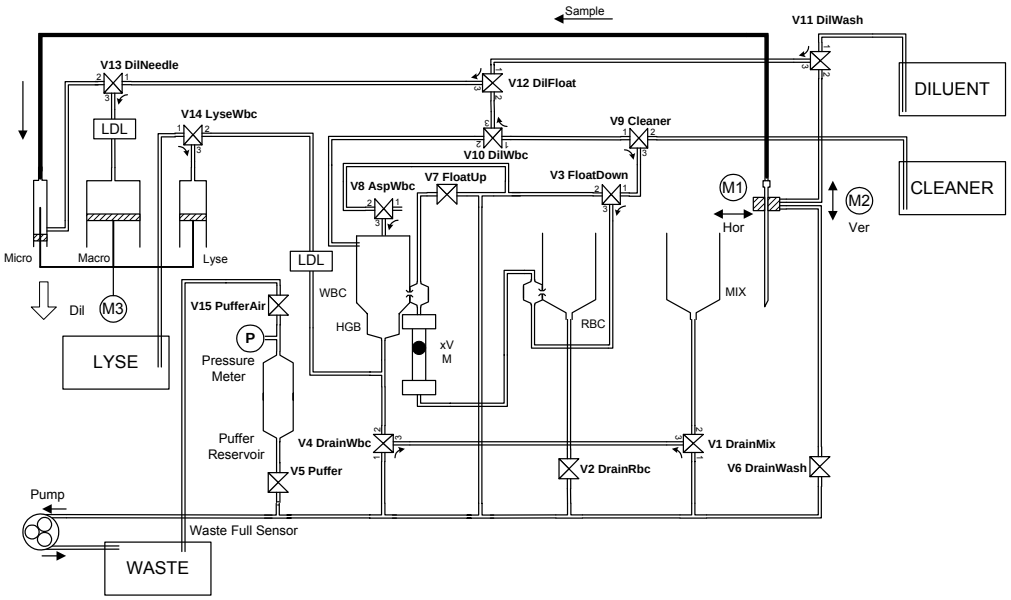
Abacus can detect the waste container's actual status by the waste full checking process. This detection is traced back to a pressure sensing method. The V15 valve switches the measuring vacuum to the waste full sensor tube for a short time (10 msec). The pressure meter measures the decrease of the vacuum during this time. From this value the program can decide that the vacuum has aspirated fluid or air so the waste container is full or not.

In the **Arcus** there is **no** Waste Full Checking possibility. It is counting the volume of the reagents used, and gives a message when this volume reaches the preset tank capacity.

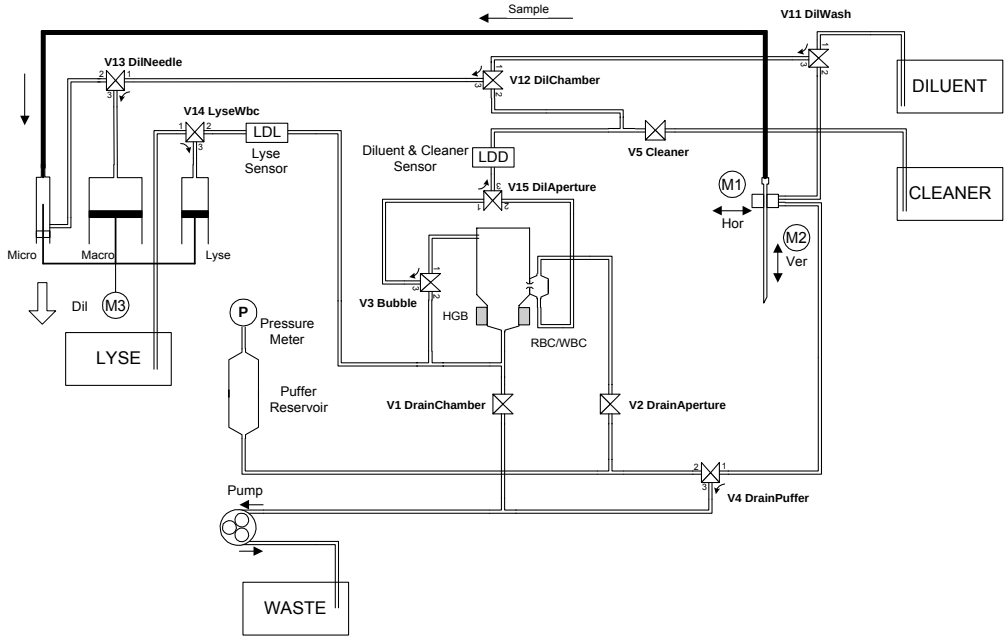
3.1. Sampling process

25 µl of blood sample is aspirated by the aspirating tip. The Micro syringe makes the aspirating while the M3 Dilutor motor moves down.

- In the **Abacus** there is another sampling process when 25 µl of primary dilution is aspirated by the aspirating tip from the MIX chamber to the RBC chamber for the second (RBC) dilution.



- In the **Arcus** there is also another sampling process for the second (RBC) dilution, 25 µl of primary dilution is aspirated by the aspirating tip from the chamber but it is kept in the aspirating tip during the WBC measurement and the cleaning process.

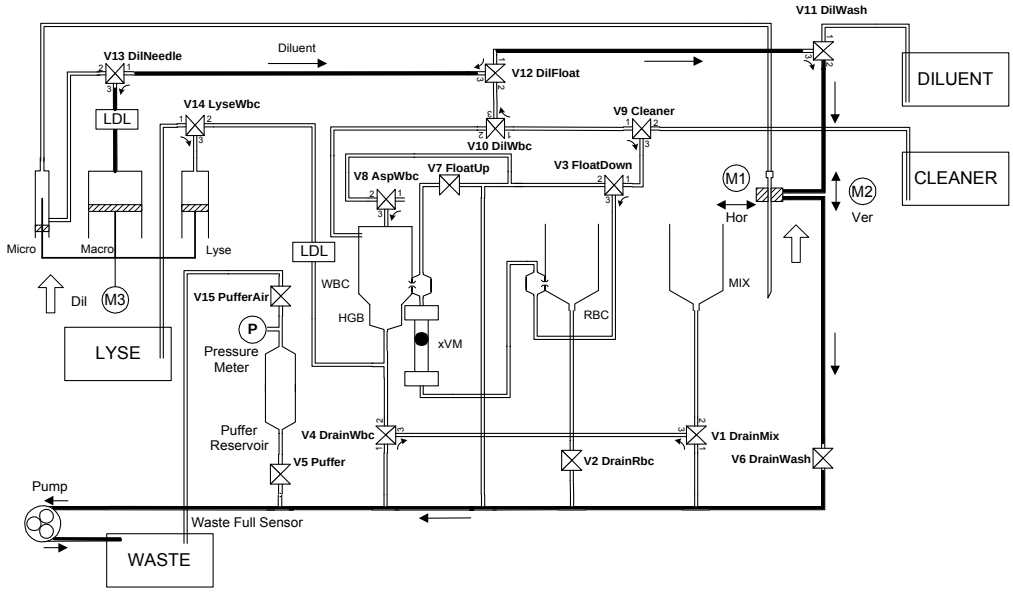


3.2. Aspirating tip washing process

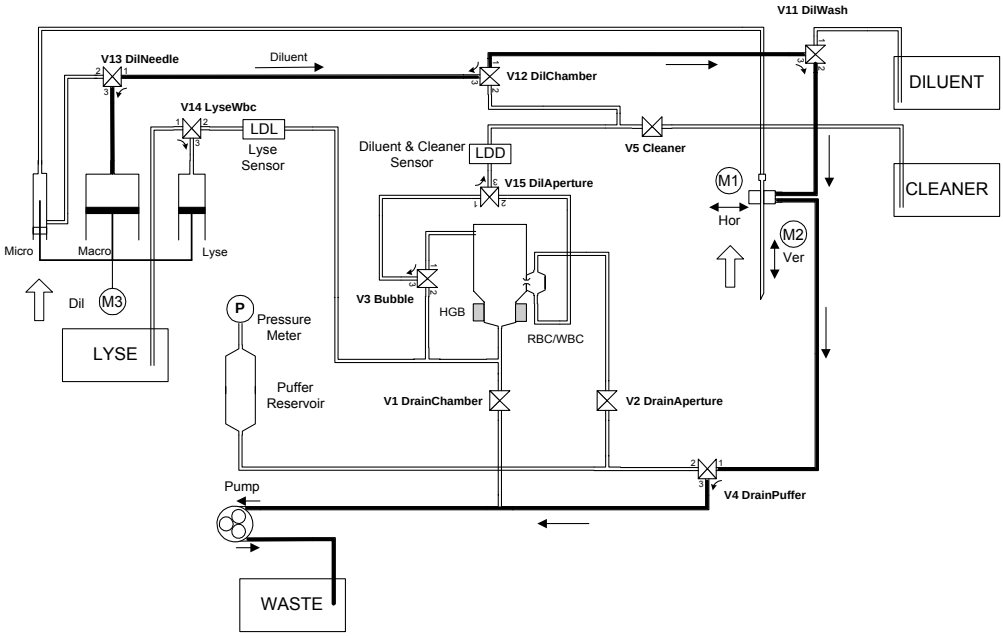
Both instruments clean the aspirating tip with diluent in the washing head after sampling. It is important to clean the outer surface of the aspirating tip to avoid inaccurate sampling.

The Macro syringe doses and the pump drains the diluent from the washing head, while the aspirating tip moves upwards so the total length of it is washed and cleaned. This process is called total aspirating tip washing. The other process, which is washing only a part of the aspirating tip, is the same but the tip does not move in the total length, just a part of it. Some procedures perform this kind of aspirating tip washing.

- In the **Abacus** the Macro syringe pushes the diluent through V13 (Off), V12 (Off), V11 (On). The Pump aspirates the diluent from the washing head through V6 (On), while the M2 Vertical motor moves the aspirating tip up.



- In the **Arcus** the Macro syringe pushes the diluent through V13 (Off), V12 (Off), V11 (On). The Pump aspirates the diluent from the washing head through V4 (Off), while the M2 Vertical motor moves the aspirating tip up.

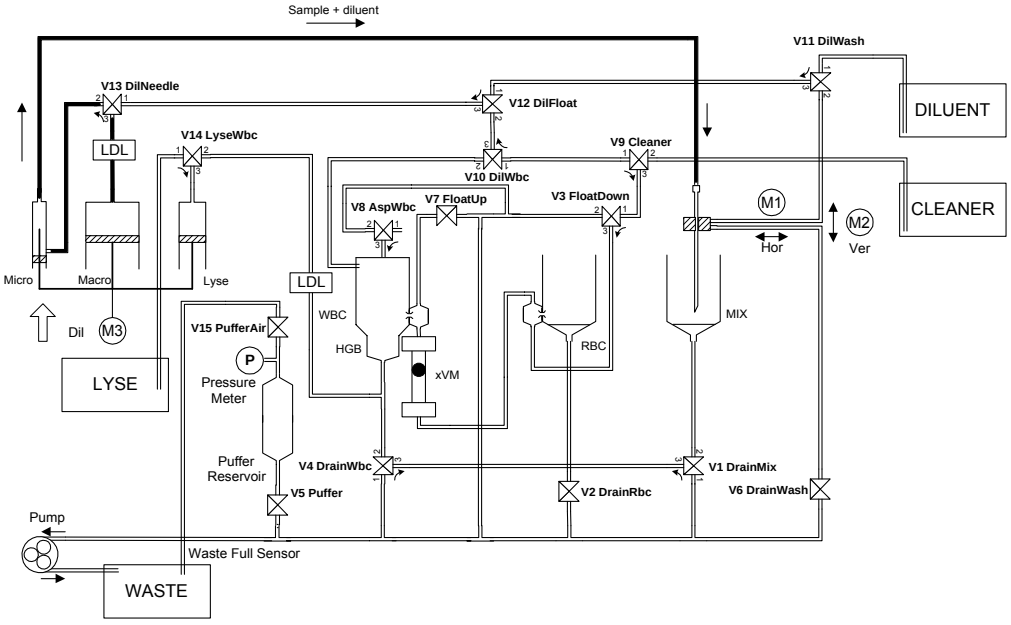


3.3. Diluting process

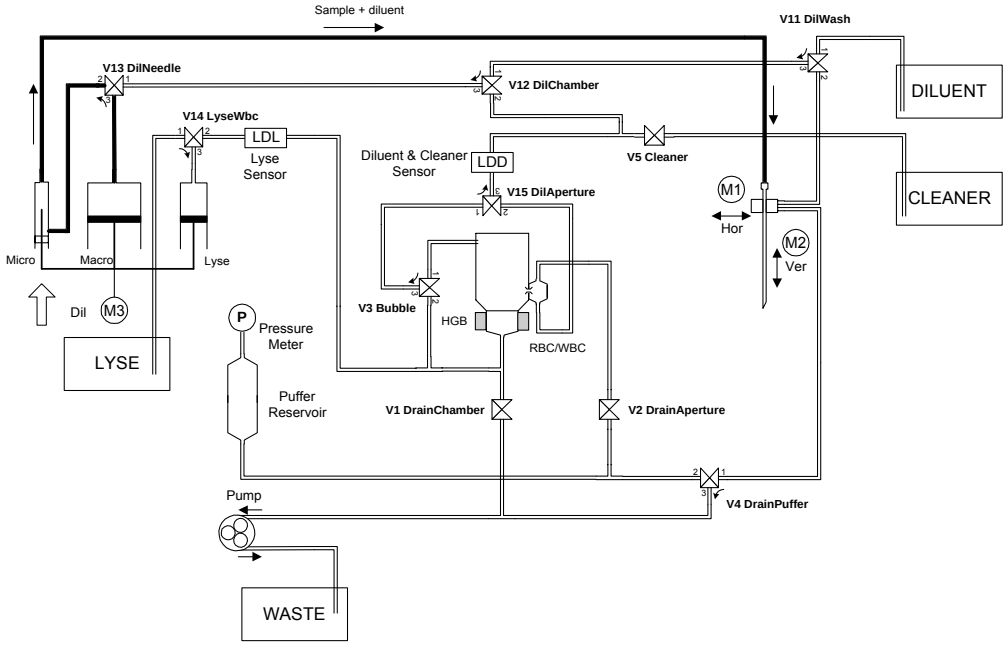
The parts of the fluidics are rinsed with diluent. MIX and RBC chambers in the **Abacus** and the measuring chamber in the **Arcus** are filled up with 1 ml of diluent. This method prevents the chamber(s) from dirt and makes the diluting process faster.

The sampling process has aspirated 25 µl of sample, which is in the aspirating tip. In the first diluting step the sample is dispensed into the MIX chamber in the **Abacus** and into the measuring chamber in the **Arcus** with 3.0 ml of diluent, which comes from the Macro syringe through V13 (On) and Micro syringe, while the M3 Dilutor motor moves upwards. This process makes the 1:160 first dilution rate in the chamber.

- In the **Abacus** the second sampling process aspirates 25 µl of primary dilution and then it is added with 5.0 ml of diluent into the RBC chamber. This process makes the 1:32,000 dilution in the RBC chamber.

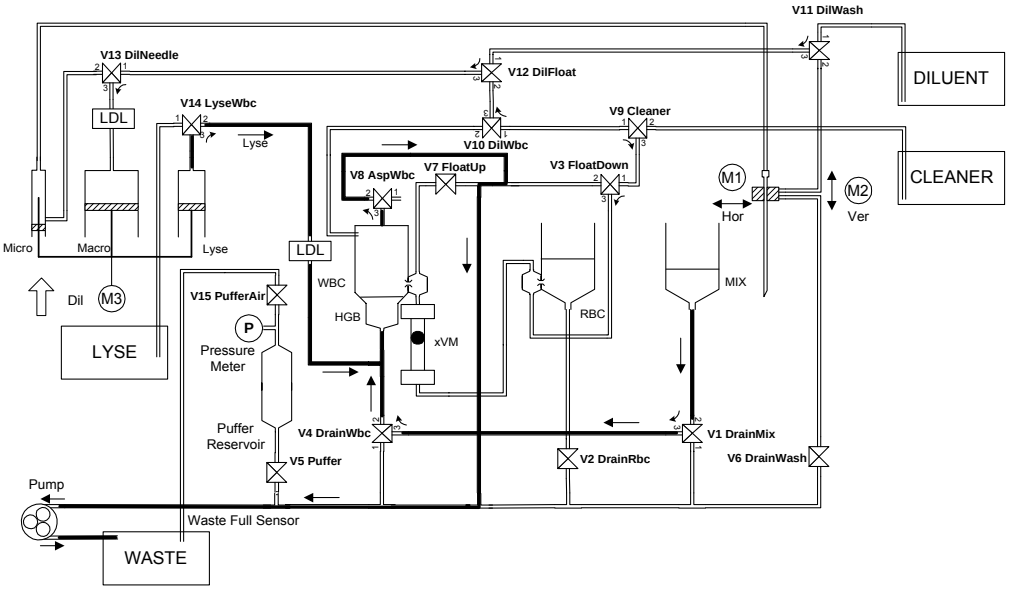


- In the **Arcus** the same dilution rates are made but the second sampling, the 25 µl of primary dilution is stored in the aspirating tip during the WBC measurement and the cleaning process and the instrument makes the second dilution into the chamber after these processes.

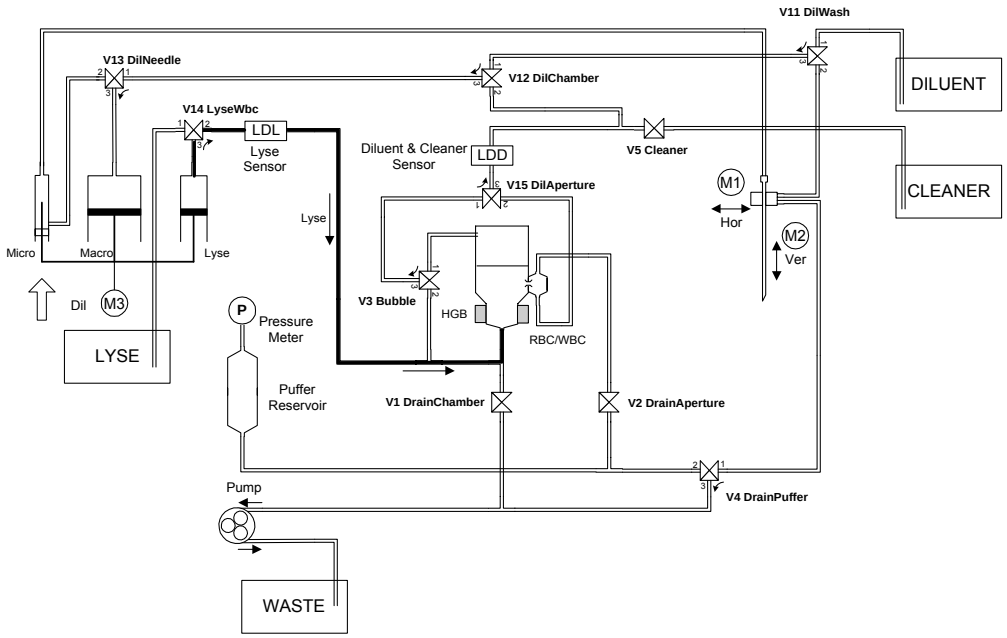


3.4. Lysing process

- In the **Abacus**, in this step the primary dilution remaining in the mixing chamber flows via V1 (On) and V4 (On) into the WBC chamber), because the vacuum - which is generated by the pump - aspirates the fluid through V8 (On), while V3 and V7 are Off. Simultaneously, 0.9 ml of lysing reagent is added through V14 (On), while the Lyse syringe moves upwards. This process makes the 1:196 dilution rate and good mixing with lyse, and at the end the mixing chamber is empty, and the specified RBC and WBC dilutions are in the proper chambers. After this step the system makes a MIX chamber washing cycle.

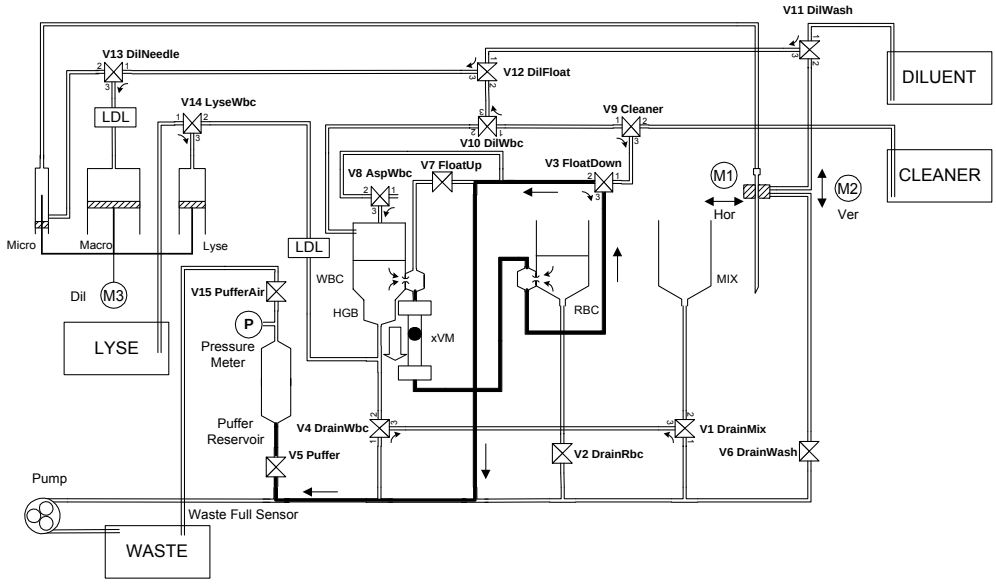


- In the **Arcus**, in this step 0.9 ml of lysing reagent is added into the measuring chamber through V14 (On), while the Lyse syringe moves upwards. This process makes the 1:196 (WBC) dilution rate and good mixing with lyse (the syringe also pushes some air bubbles for mixing).



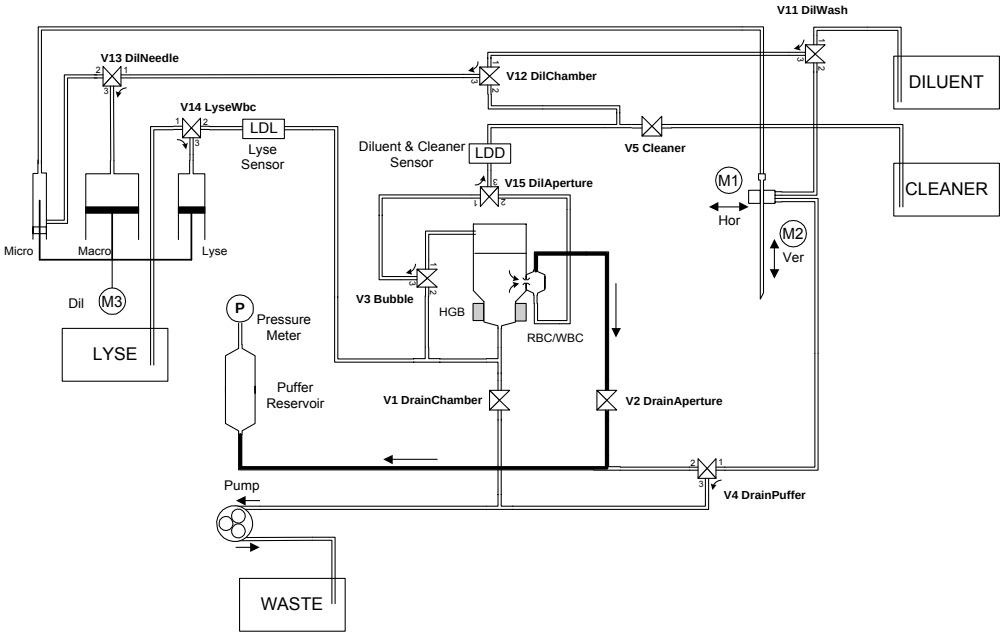
3.5. WBC counting process

- In the **Abacus** at the beginning of the WBC counting process the analyzer moves the float up by diluent reagent coming from the macro syringe. V12 & V7 are On, V10, V9 and V3 are OFF, and pump drains the reagent. By this time the pump has generated the regulated vacuum in the puffer reservoir.
  After that, the vacuum aspirates the diluted sample from the WBC and RBC chambers through V3 (ON) and V5 (ON) valves while all others are OFF (during this the pump is OFF which is equivalent with a closed valve). Both WBC and RBC samples are flowing through the aperture but the float measures only the WBC sample volume by moving down until the lower opto switch is off. When the float reaches the lower opto, V3 is closed. In this state the HGB measurement is executed.



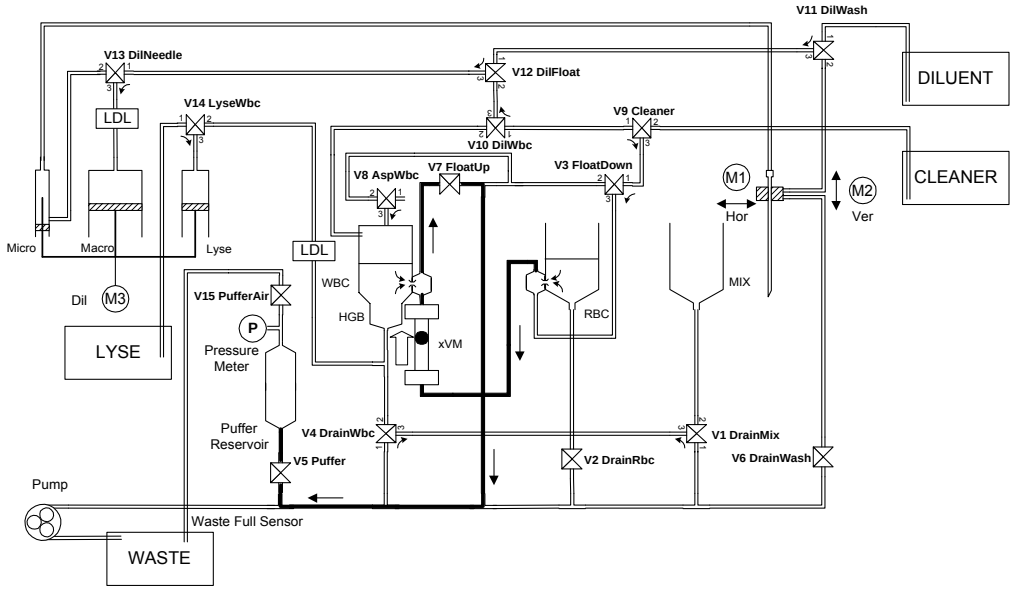
- In the **Arcus** the regulated vacuum (it is generated by the pump in the puffer reservoir) aspirates the diluted sample (WBC) from the chamber through V2 (On) valve. In the **Arcus** there is no volume limiter and the instrument counts the cells for 8 seconds.

  At the end of this process the HGB measurement is executed.



3.6. RBC counting process

- In the **Abacus** the RBC counting process is executed immediately after the WBC counting process so the float is at the lower opto sensor. The measuring vacuum (which is in the puffer reservoir) aspirates the RBC sample through V7 (ON) and V5 (ON) valves while the V3 valve is OFF. Both, the WBC and the RBC samples are flowing but the float measures only the RBC sample volume by moving upwards. With this method a predefined sample volume can be measured, but he WBC and the RBC measuring times are different because the diameter of the cellcounter probes are not the same.



- In the **Arcus** the RBC counting process is absolutely the same as the WBC from the pneumatical point, but the diluted sample - which is aspirated by the regulated vacuum from the chamber - is the second dilution rate made by the second dilution process. RBC counting time is also 8 seconds.

3.7. Washing processes

Both instruments make lot of washing processes such as MIX chamber washing and WBC, RBC chambers washing processes in the **Abacus**, and chamber washing process in the **Arcus**. The systems has a two-steps washing method, which ensures a very low carry over between measurements. At the first step - called pre-washing - 1 ml of diluent washes the actual chamber and the pump drains it. At the next step - called main washing - the actual chamber is primed with diluent. This diluent volume is higher (+ 0,2 ml) than the chamber's operating sample volume.

Sometimes (for example the MIX washing in the **Abacus**) this second diluent is not drained immediately after the washing process but it stays in the chamber protecting it from possible soiling. In that case the chamber is drained at the end of the total washing process.

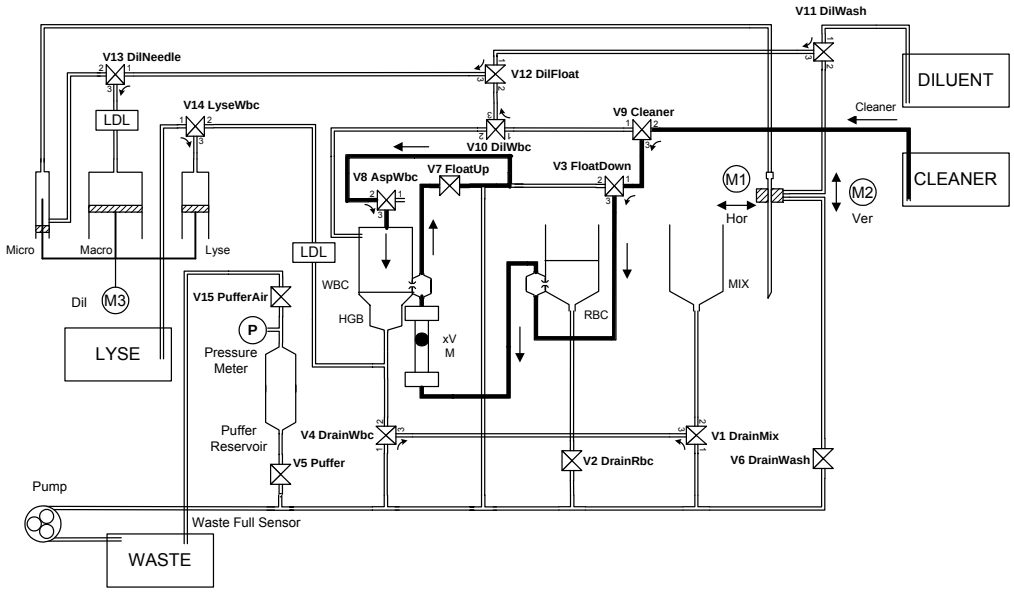
Draining is a very simple fluidic method. The Pump aspirates the fluid from the actual chamber or tube through its valve is On while the other valves are Off.

In the **Arcus** the washing processes also use Cleaner solution to clean the chamber from the lyse reagent between the WBC and RBC measurements and after each measurement cycle.

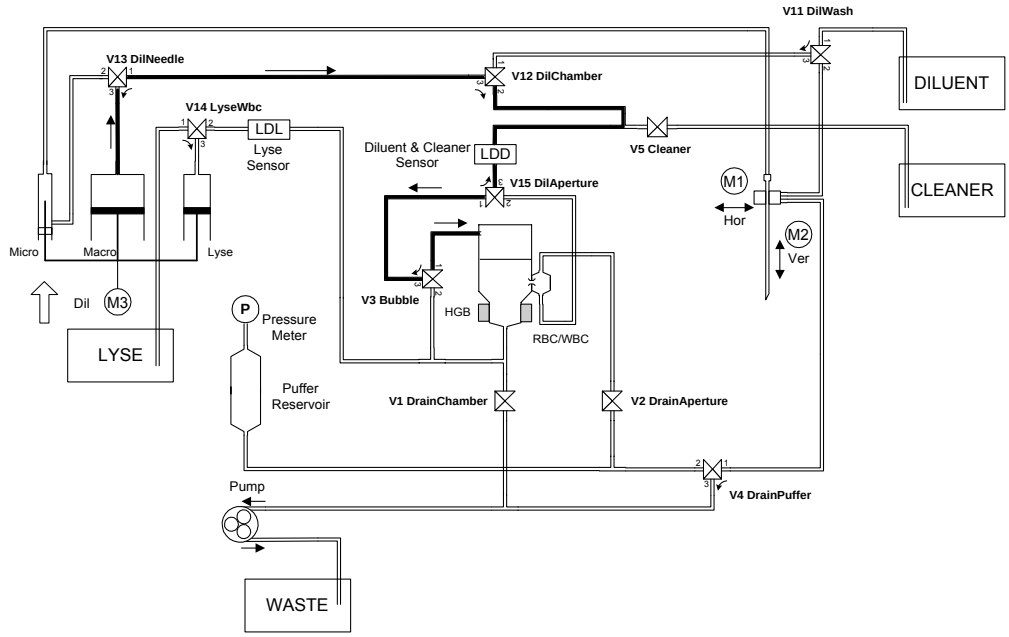
3.8. Cleaning process

- In the **Abacus** the system can clean the apertures and the volume limiter with a special cleaner reagent. The pump aspirates the cleaner through the V7 (On), V3 (Off) and V9 (On) valves.

After that the instrument cleans the WBC chamber with the cleaner reagent (for details see 6.4). The instrument generates vacuum in the WBC chamber (with the pump), and after that this vacuum aspirates the cleaner reagent into the WBC chamber through V9 (On), V3 (Off), V7 (On), V8 (On). This second process is called **Autoclean** (see the figure), which is a part of the normal cleaning cycle.



- In the **Arcus** the pump aspirates the cleaner through the V5 (On), V15 (On), V2 (On) and V4 (On) valves to clean the aperture. After that the instrument cleans the chamber with the cleaner reagent that remained in the tubes between V12, V5 and the liquid detector (Dil. and Cleaner detector): the Macro syringe pushes diluent and cleaner reagents (from the tubes) through V13 (Off), V12 (On), V15 (Off) and V3 (On) into the chamber.



4. ADJUSTMENT

There are some very important mechanical and hardware settings in both (**Abacus** and **Arcus**) systems and there are some software settings, which are available only for Service Personnel. The mechanical and hardware adjustments are described in this section. Special software settings are included in the 5.2 section of this Service Manual.

4.1. Mechanical settings

There are two very important and necessary mechanical settings in both instruments:

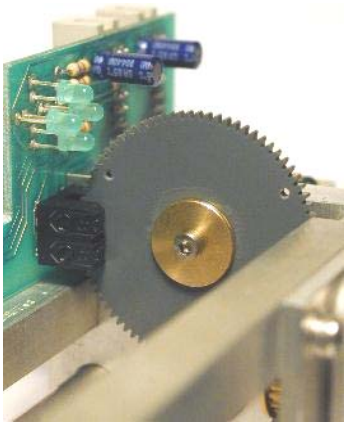
- **Opto wheel setting**
- **Aspirating tip setting**

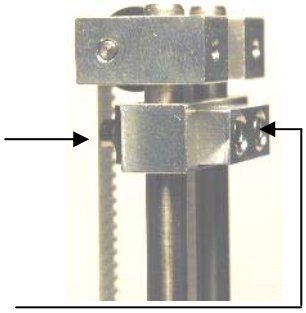
> ***The analyzer is adjusted by the manufacturer before the use but there is a possibility to change any part of the mechanical system and in this case the Service Personnel must do these very important and special settings. The omission of these settings can cause malfunction or damages to the instrument.***

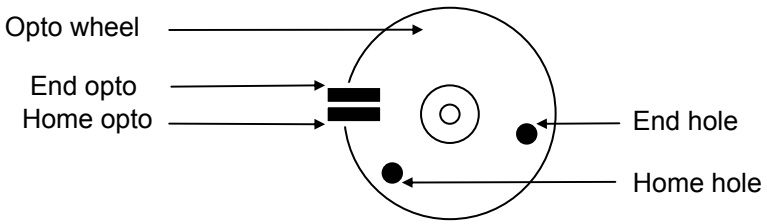
4.1.1. Opto wheel setting

This setting is necessary for the vertical motor movements because this adjustment sets the opto detectors of the H&V moving unit. The top of this block is called HV head and it is shown in the figure.

Set the distance to **2-3 mm** between the two parts of the head.
Loose the „A" screw for free movement on the timing belt.
Adjust the opto wheel to the home position while the head stays untouched. Fix the „A" screws.





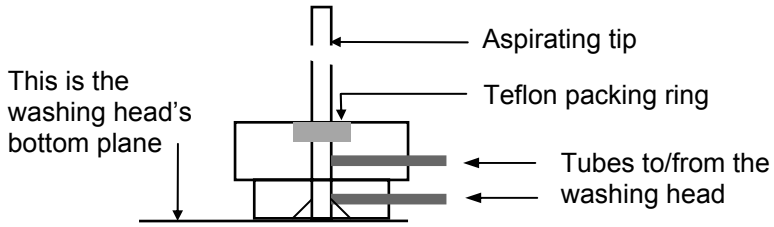


The home position is when the home hole is in the home opto. The H&V opto board's LED indicate this state. After that check the end position, too: move the vertical unit to the lowest position (it is indicated by LED) in that state **1-2 mm** distance must be between the mobile part of the head (carriage) and the bottom of the H&V moving unit.

4.1.2. Aspirating tip setting

This adjustment sets the aspirating tip to the operational position. Set the distance between the two parts of the HV head to 5 mm. Loose the „B" screws and adjust the aspirating tip to its operational position.

There is the washing head in the bottom of the H&V moving unit, which is shown in the next figure. Set the point of the tip to the washing head's bottom plane while the HV head is untouched. Fix the „B" screws.



After this setting switch the instrument off and on again and wait for be at a standstill. The analyzer always stays in the same state in which the aspirating tip must be in its operational position. Check the position of the tip and if it is necessary make the adjustment again.

4.2. Hardware settings

The most part of the hardware settings is adjusted by the manufacturer and it is not required to reset these settings. There is only one part in both instruments, which claims some adjustment; this is the sensitivity of the liquid detectors.

4.2.1. Adjustment of the liquid detector sensitivity

Without any reagents, set the Dil. and Lyse potentiometers in the PCPRO board to reach the state, when the LED goes off. After that turn the potentiometers counterclockwise to reach the on state (the LED is on) and after that turn 180° more in the same direction.

To check the proper operation of the liquid detectors, use the indicator LEDs:

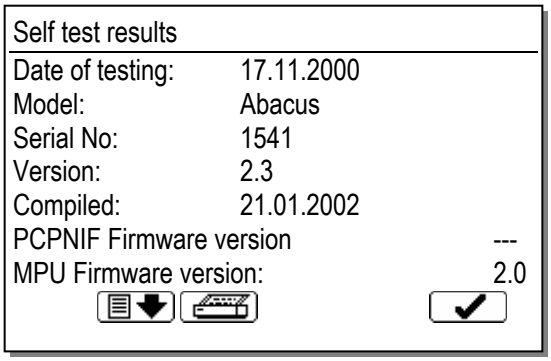
No reagent	LED is on
Reagent, with bubbles	LED sometimes turns on
Reagent, without bubbles	LED is off

5. CHECKING THE PROPER OPERATION

Both analyzers have built-in Self test and Service menu.

5.1. Self test

5.1.1. Self test Screens



Self test can be used to check the operation of the instrument.

The first panel shows general information about the instrument. (See menu on the left.)

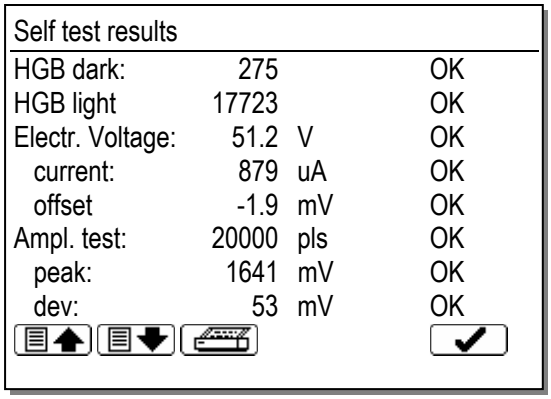
With the new MPNIF card, the PCPNIF firmware version is empty, and the MPU firmware version holds the MPNIF version number.

The second and third panel contains tested parameters, as follow:

HGB dark count (HGB LED is off, this parameter is always zero in the **Arcus**), **light** (LED is on).

Measuring **Electrode voltage**, **current offset**.

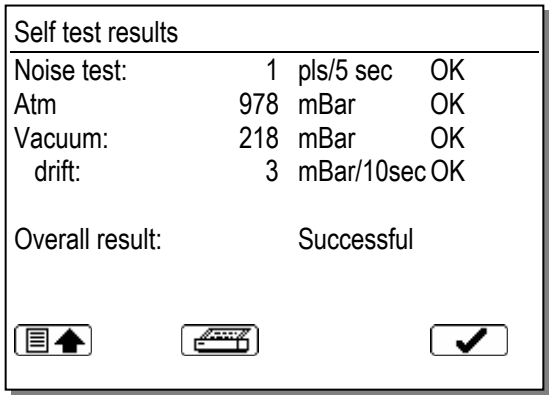
Amplifier transfer by generating 20000 pulses, incl. gain related **peak** value, related **dev**iation.


Self test results
HGB dark: 275 OK
HGB light 17723 OK
Electr. Voltage: 51.2 V OK
current: 879 uA OK
offset -1.9 mV OK
Ampl. test: 20000 pls OK
peak: 1641 mV OK
dev: 53 mV OK

and

and

test noise


Self test results
Noise test: 1 pls/5 sec OK
Atm 978 mBar OK
Vacuum: 218 mBar OK
drift: 3 mBar/10sec OK
Overall result: Successful

Amplifier **Noise test** during a 5-second period.

Atmospheric pressure stands for outer pressure.

Vacuum reports pump operation (vacuum made by the pump in a 10-second period of time).

Drift represents pressure loss of vacuum measured in a 10-second period of time.

Overall test result is displayed, which can be *Successful* (in case of every test result is *OK*) or *Errors* (if *HIGH, LOW* or *ERROR*).

At the end of a **result line status message** is displayed, which means that the actual test result is at the normal range (*OK*), higher (*HIGH*), lower (*LOW*) than the pre-determined limits, or the result is an error (*ERROR*).

Normal range of the tested parameters

Parameter	Unit	Lower bound	Upper bound
HGB dark	count	0	3000
HGB light	count	3000	50000
Electrode voltage	V	45	55
current	µA	830	930
offset	mV	-5.0	5.0
Amplifier test	count	19990	20050
peak of pulses	mV	1300	1700
deviation (noise)	mV	0	100
Noise test	pls/5sec	0	50
Outer pressure	mBar	600	1100
Vacuum	mBar	125	250
Drift	mBar/10sec	0	10

5.1.2. Troubleshooting Guide for Self test

Parameter	Mark	Possible reason	Remedy
HGB dark	*HIGH*	Instrument door open	Close instrument door
HGB light	*LOW*	HGB head not connected or HGB LED out of order	Check HGB head connections check HGB LED during measurement
	HIGH	Instrument door open or HGB LED too bright	Close door or replace HGB LED resistor on amplifier board
Electrode voltage	*LOW* or *HIGH*	Fault on High Voltage or Amplifier board	Check measuring voltage (50V) on High voltage and Amplifier boards
Current	*LOW* or *HIGH*	Fault on Amplifier board	Check current generator, relays and test generator FET on Amplifier board
Offset	*LOW* or *HIGH*	Fault on Amplifier board	Check the offset potentiometer on Amplifier board
Amplifier test	*LOW*	MPNIF and Amplifier Boards not connected	Check cables and connectors between MPNIF and Amplifier
	HIGH	Instrument not grounded	Check mains ground lead
Peak of pulses	*LOW* or *HIGH*	Fault on Amplifier board	Check current generator, relays and test generator FET on Amplifier board
Dev. (noise)	*HIGH*	Instrument not grounded	Check mains ground lead
Noise	*HIGH*	Instrument not grounded	Check mains ground lead
Outer pressure	*LOW* or *HIGH*	Pressure sensor, cable, amplifier or PIC#0 error	Check pressure sensor on PRO board, cable connections and MPNIF board pressure amplifier
Vacuum	*LOW*	Peristaltic pump failure	Check peristaltic pump
Drift	*HIGH*	Leakage in pneumatics	Check tubing in pneumatics

5.2. Service Menu

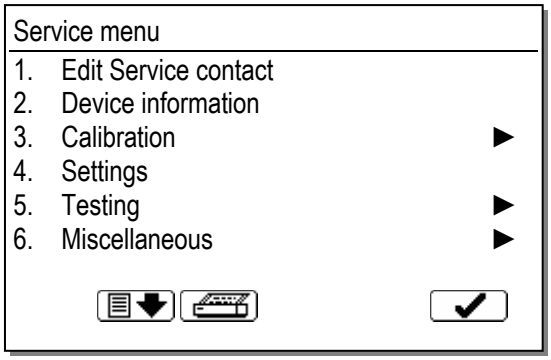
5.2.1. Entering to Service Menu

There is a Service menu for servicing and operation checking purposes. The entry point is in the User's Service screen, where Service Information is displayed.

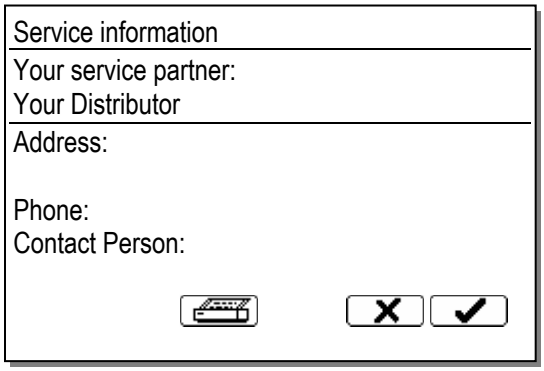
Enter the code to access Service menu: 6484

Main Service Menu

The Main Service menu provides access to submenus and service utilities.



5.2.1.1.Edit service contact

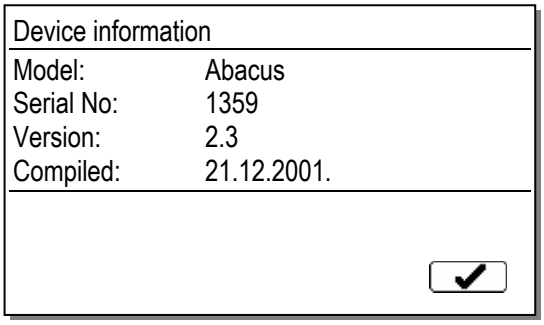


Here you can edit the Information card fields by cursor keys, or by an external keyboard.

Press the OK button, if a field is completed.

This information will appear in the User Service menu.

5.2.1.2.Device Information



In the Device Information menu the model name, the serial number, the software version and compilation date appear.

5.2.1.3.Service Calibration

Diatron provides a menu for Service calibration purposes.

In result calculations the service calibration factors are used as the user calibration factors, so they are multiplied for each parameter: $\mathbf{RBC_{Disp.} = Fact_{RBC\ User} * Fact_{RBC\ Serv.} * RBC_{Measured}}$

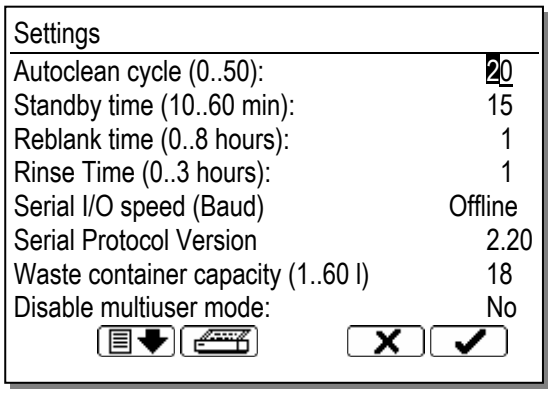
If the user factor is near the bound (0.80 - 1.20), by setting the corresponding service factor, the user factor can be adjusted to 1.00.

$\mathbf{Fact_{RBC\ User}}$ = 1.19 and $\mathbf{Fact_{RBC\ Serv}}$ = 1.00, **and** $\mathbf{Fact_{RBC\ User}}$ = 1.00 and $\mathbf{Fact_{RBC\ Serv}}$ = 1.19 gives the same result for RBC.

The **apply user** calibration **factors** function can be used to exchange the previous user and service factors, automatically. If all service factors were 1.00, after this function all service factors hold the previous user factors, and all user factors become 1.00.

5.2.1.4.Software Settings

Service Person can set the parameters of the automatic functions in this dialog menu.


Settings
Autoclean cycle (0..50): 20
Standby time (10..60 min): 15
Reblank time (0..8 hours): 1
Rinse Time (0..3 hours): 1
Serial I/O speed (Baud) Offline
Serial Protocol Version 2.20
Waste container capacity (1..60 l) 18
Disable multiuser mode: No

Autoclean cycle: after how many measuring cycles the instrument makes an autoclean process (default = 20 cycles). This setting is effective only for Abacus. Zero means **never**!

Stanby time: after how many minutes the instrument goes to standby mode (default = 15 min).

Reblank time: after how many minutes the instrument makes a blank measurement if it was in stanby mode (default = 1 hour). If it is set to 0, then no ReBlank is performed.

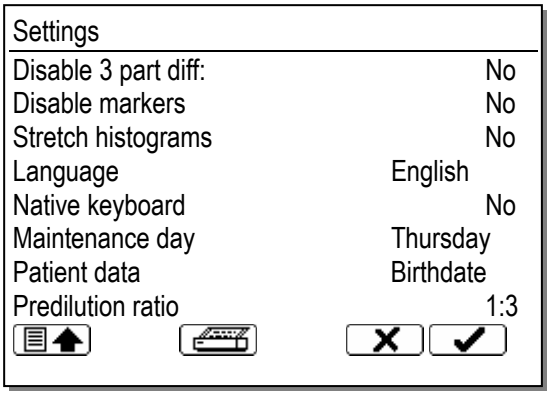
Rinse time: If this time is set, then the instrument will make an automatic, extended washing procedure (with more diluent) of the chamber(s) to get wash dirt out of the chambers (dust). If it is set to 0, then no Rinse is performed.

Serial I/O speed: instrument can send results to a host computer via serial port with the RS 232 V24 protocol. The baud rate of this serial communication must be selected at this point. For details of the serial communication protocol, see Appendix 9.2 in this manual.

Serial Protocol Version: with this option, the used protocol (sending specific fields or not) can be selected. This is useful when a new software (with more stored e.g. patient info) is installed in laboratory system, where an earlier serial protocol has been implemented.

Waste container capacity: for the Arcus it essential to set the correct volume of the waste container for proper usage of the software ”waste full” alert. Set this value 2 liters less than the total volume of waste container. (This option is only available in Arcus)

Disable multi-user mode: by this setting the multi-user mode can be disabled



Disable 3-part diff.: for using quick lyse (without 3-part differential) the errors and the bad 3-part parameters can be excluded from the results

Disable markers: setting this option to Yes will omit the markers from the reports

Stretch histogram: setting this option to Yes will modify the WBC histogram range from 0-300 fl instead of 0-400 fl (this is recommended for Veterinary mode)

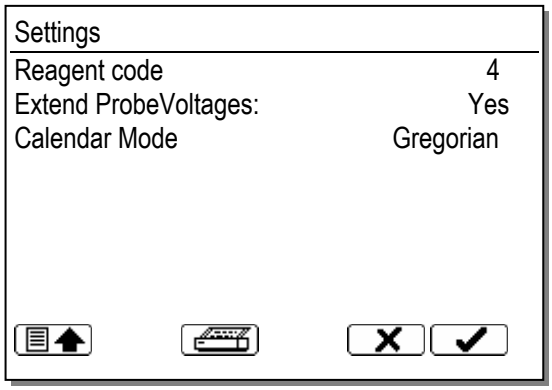
Language: this setting will adjust the user language. The Service menu always uses English language.

Available languages: Arabic, English, French, German, Greek, Hungarian, Indonesian, Italian, Portuguese, Romanian, Russian, Spanish and Vietnamese.

Native keyboard: Setting it to Yes will utilize the external PC keyboard with the language specific layout.

Maintenance day: You can select among the days of the week. According to this setting, the instrument will ask the user to do the weekly maintenance when shut down.

Patient data: There are two options: Birthdate and Age. According to this setting, both in the sample information dialog and in the database, the instrument will prompt for the age or the date of birth. If age is specified, it can be given in years or months.



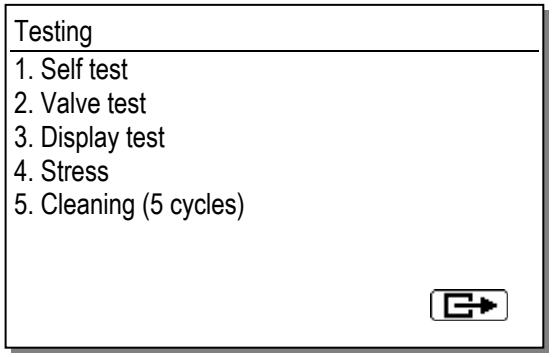
Reagent code: This code can be used to modify the offset of the HGB function. Enter a value between 0 and 30.

Extend ProbeVoltages: This option is ON by default. It makes the instrument accept the physically highest probable probe voltages, and to validate and extend the operating temperature range, or the accidentally higher PrV of the “first blank” measurement.

Calendar mode: You can select between the Gregorian and the Jalaali (Persian) calendar. All dates will be converted accordingly.

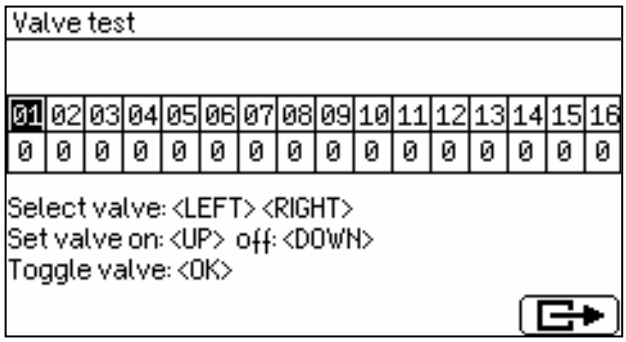
5.2.1.5.Service Testing Menu

Service Testing menu provides tools for checking hardware.



From this submenu the Service Person can directly run the built-in **Self test** (see 5.1).

5.2.1.5.1. Valve Test Menu



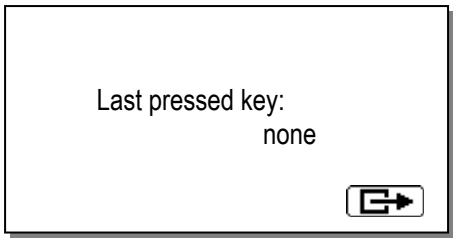
In the menu on the left you can see the valve numbers and a number under each that represents the actual state of the valve. **Valve 16 means peristaltic pump**.

Selected valve number is shown in inverse. 0 is **Off** state, 1 is **On** state.

Use cursor keys for selecting and setting valve state, or press OK to toggle state.

In the **Arcus** there are no valves 6-10.

5.2.1.5.2. Display and Keyboard Test



Display and keyboard test is provided to check keypad and LCD panel.

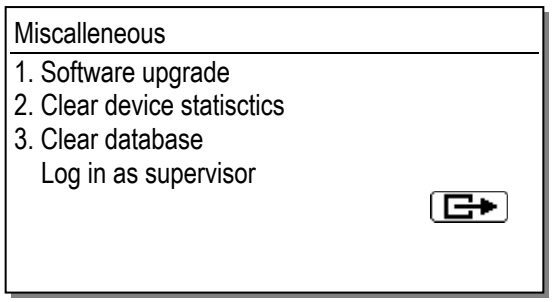
Press a key to test and the LCD will show the code of the pressed key, and will be invert the colors at each touch of a key for testing that every LCD dot is functioning.

5.2.1.5.3. Stress

In **Stress mode,** the instrument performs measuring cycles without sample (blank measurements) continuously. This can be used for burn-in tests, or to check pneumatic system after changing any main fluidic parts.

To exit from this mode **press the START button** (at the end of a normal cycle) until the Stress operation is finished.

5.2.1.5.4.Miscellaneous settings



In this menu, you can directly perform **Software upgrade** (this will restart the instrument).

Clear Device Statistics: Device statistics (number of measurements, aperture-clogging and other errors) can be cleared.

Clear Database: The whole Database (measurement results including histograms) can be cleared.

You can **Log in as supervisor** if the Multi user mode was selected in the User's Settings submenu. (Number 4 if present, shows the availability of this function.)

In supervisor mode, you have the ability to change any user passwords and you have full access over user settings. **Always log out after this supervisor log in.**

5.2.2. Multiuser Rescue Code

It the supervisor password has been forgotten, there is a rescue code for service purposes to access the supervisor level. The Service user data are as follows:

User ID: **0** (zero),
Name: **Service,**
Password: **729456** (This forms a capital "A" on the keypad)

6. SERVICE OPERATION

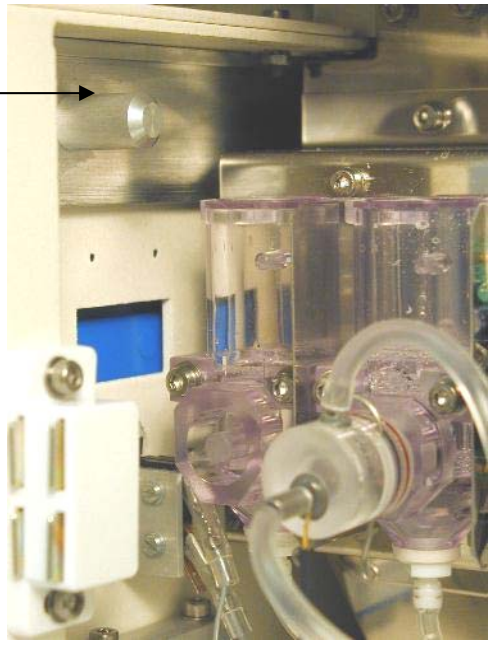
6.1. Open the instrument

The left side of both instruments is a side door, which allows to reach the fluidic system easily. Other parts of the analyzers can be approached by opening the cover.

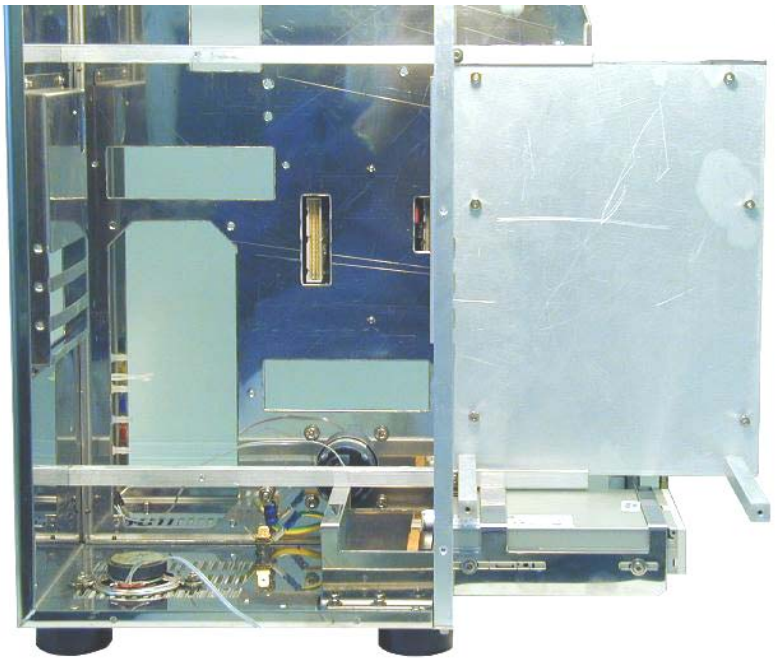
- In case of **Abacus**: first unscrew the 3 cover fixing ("Z") screws located on the rear panel. After this, open the left side door. In the front part of the analyzer there is a special zip-fastener as it is shown in the figure.

  Push this fastener to the direction of the arrow this will unlock the fastener and after that the cover is ready to open. Pull the cover upward to open the instrument.

  To lock the cover, pull the fastener to the opposite direction.



- In the **Arcus** there is no special fastener for the cover; by unscrewing the cover fixing screws on the rear panel the cover is ready to open. But this instrument has a special rack system for the mainboard holder plate:



By loosening the mainboard holder plate fixing screws on the rear panel the Service Personnel can pull out the entire mainboard holder plate with the mainboard from the front of the instrument and access the back of the assembly plate.

The figure shows an unassembled **Arcus** for easier understanding.

6.2. The parts of the analyzer's computer

- **Mainboards** from different manufacturers (Acorp, Epox,…) are used in the instruments, but in these applications the different mainboards' properties can be considered equivalent. The mainboard includes a **CMOS battery** that allows storing the BIOS settings during power down.
- The **processor** is installed on the ZIF socket 7 of the mainboard and it has a **cooler fan**, which is fixed to the processor with glue. The CPU voltage and clock (CLK) is set by the manufacturer, the required settings are enclosed in the Main Board Manual, which is a part of the **Abacus/Arcus** base package.
- The system **memory** is minimum 16MB, SDRAM module. There is no jumper or connector needed for memory configuration.
- There is **no hard disk** in the systems, the instruments use **DiskOnChip®** modules, which are placed on the MPNIF cards. These modules are more reliable, there are no moving parts in them and the User can use them like normal hard disks. Abacus's MPNIF card contains 16 Mbytes; Arcus's MPNIF card contains 8 Mbytes DiskOnChip module.
- The **floppy disk drive** is connected to the mainboard with ribbon cable. The required configuration of the floppy disk drive (boot sequence, swap) is written in the BIOS settings section.
- The **video adapter** (MDA: Monochrome Display Adapter) and **video memory** are placed on the MPNIF card. With this new feature the instrument can use the LCD like a computer monitor without any plus cards (VGA).

6.3. The MDA (Monochrome Display Adapter) emulation mode

MDA emulation mode was developed to help the manufacturer and Service Personnel in the checking phase of the instruments. This mode is available during the total operation but especially useful for checking the BIOS setup and OS functions. This mode should be handled the same as the service menu, the user does not have to know these options.

At power-on, the controller PIC on MPNIF card is configuring the FPGA chip and displays the greeting screen. After 6 seconds, it starts to scan the keypad and behaves like an **MDA** adapter to the PC, although the displayed screen is still holding the greeting screen.

If you switch to **MDA emulation mode**, the system boot events can be displayed, and the CMOS SETUP program can be started, if necessary.

If the main program will not start in 90 seconds, the PIC will automatically switch to MDA displaying mode to give information about the reason of hang-up. This can be some CMOS failure, if the motherboard settings are lost for some reason, and the system is waiting for user confirmation: F1 **on external keyboard,** or running setup - both require external keyboard to be connected.

Hold the „**?**" button, and press and release the „**.**" button on the foil keyboard of the analyzer to activate the **MDA** mode, which uses the LCD like a primary computer monitor (80 characters by 25 rows). The LCD is smaller than the standard monitor area therefore just about a quarter of the total screen is displayed (40 characters by 16 rows).

- to change the actual quarter displayed, use the arrows (cursor keys) on the keypad,
- to go where the cursor is, press the „**?**" button,
- to go back to the normal graphic displaying mode press „**? .**" again.

6.4. Key BIOS settings for correct operation

The required settings are enclosed in the Main Board Manual, which is a part of the **Abacus/Arcus** base package. Mention must be made for some cardinal points:

- **Standard CMOS setup:**
  - Hard disk: Auto
  - Floppy drive A: 1.44 M, 3.5 in.
  - Floppy drive B: **1.44 M, 3.5 in.** **This is very important!**
  - Halt on: **No errors** **This is very important!**
- **BIOS features setup:**
  - Virus protection: Disabled
  - CPU internal cache: Enabled
  - External cache: Enabled
  - Quick power on selftest: Enabled
  - Boot sequence: A,C
  - Swap floppy disk: **Disabled** **This is very important!**
- **CHIPSET features setup:**
  - Auto configuration: Enabled
- **Power management:**
  - ACPI functions: Disabled
- **PNP/PCI configuration:**
  - PNP OS Installed: No
  - Resources controlled by: Manual
  - All IRQ settings should be : PCI/ISA PnP, except for
  - IRQ9, 10, 11 and 15: Legacy ISA
  - IRQ activated by: Level
- **Integrated peripherals:**
  - IDE HDD Block mode: Enabled
  - Other settings should be: Auto (PIO mode, etc.)
  - On-Board FDC Controller: Enabled
  - Serial Port 1: Auto or 3F8/IRQ4
  - mode: Normal
  - Serial Port 2: Auto or 2F8/IRQ3
  - mode: Normal
  - Parallel Port: Auto or 378/IRQ7
  - mode: SPP

6.5. Checking the BIOS setup

It is suggested to check it if the instrument hangs after switching on, or software does not start (or cannot be upgraded from floppy disk).

- Connect an external keyboard (US layout) to the instrument and switch it on
- Switch the instrument to MDA emulation mode "**?.**" on the keypad
- When the message appears "Press Del to enter setup", press Del on the keyboard
- Check the key points listed above (or from the enclosed Main Board Manual), if you find differences, set these settings using Page Up key
- Go to "Save to CMOS and EXIT". Press the key "Y" or the key, which is in the second row in place of the "Y" "QWERTY" (English standard) to Save the new settings
- The instrument will restart with the new (correct) BIOS setup configurations

6.6. DOS functions on the instrument

To run the computer part of the instrument like a normal PC, the Service Personnel should have an **MS-DOS** 6.22 operating system **boot floppy** disk (the earlier instruments had their own DOS operating system, but the new ones work without any commercial operating system).

- Connect an external keyboard
- After turning on, switch to MDA mode "**?.**"
- Go to the BIOS setup (press Del on the keyboard)
- Change the ***Swap floppy drive*** in the BIOS features setup menu to **Enabled** (the default setting is Disabled)
- Save the actual settings to CMOS, the instrument will restart
- Put the MS-DOS boot floppy into the floppy disk drive
- The instrument will boot from the floppy and the software will be terminated
- This mode gives facilities to the Service Personnel to run DOS functions (scandisk) for checking the DiskOnChip, the mainboard, and the floppy disk drive
- Do not forget to **Disable *Swap floppy drive*** after servicing, because the floppy must be **B:** for the **Abacus/Arcus** software

6.7. Error messages

The analyzer checks the operations of several mechanic, fluidic and electronic parts during measurement. The system shows the type of the error on the LCD display if any kind of malfunction is detected.

The electronic parts have a very little chance to fail, only the connections and cables could disconnect, which can cause the malfunction of the electronic system. The mechanic and fluidic system have a bit more chance to go wrong because it has moving parts.

In 6.7.1 section there is the total error code list.

6.7.1. Error code list

%s: filename concerned

%d: error type concerned

%u: error specific string

Code	Error text	Reason(s)	Remedy
1000	Out of memory in %s	Fatal system or program error!	Check the MPNIF card and memory module for proper insertion. Try to make a software upgrade.
1001	Error %d on opening file %s	Fatal system or program error!	The same as in case of error code 1000.
1002	Cannot create file %s	Fatal system or program error!	The same as in case of error code 1000.
1003	Data file %s is corrupt, new will be created, all stored measure data will be lost	Stored data file is corrupt or missing! Disk or software error.	New stored data file will be created automatically (by a User confirmation).
1004	Error %d on indexing file %s	Fatal system or program error!	The same as in case of error code 1000.
1100	Fatal pressure error. Power off the system!	Cannot make the measuring vacuum!!	Check the pump and the tubes, fittings and valves around the puffer reservoir.
1101	Waste is full! Empty waste container! The system assumes that you will do it before going on!	Waste container is full!	Empty waste container! If it is not full, there is a clogging in the waste sensor line.
1102	Check Diluent container!	Diluent reagent container become empty, or the diluent fluid sensor is too sensitive or there are a lot of bubbles in the diluent tubes!	Replace the Diluent reagent container with a filled one. If this still a problem with a filled diluent reagent container, reset the sensitivity of the dil. sensor and check the tubings and the fittings.
1103	Check Lyse container!	Lyse reagent container become empty, or the lyse fluid sensor is too sensitive or there are lot of bubbles in the lyse tubes!	Replace the Lyse reagent container with a filled one. If this still a problem with a filled lyse reagent container, reset the sensitivity of the lyse sensor and check the tubings and the fittings.
1104	Timeout occured. Try cleaning!	The float in the volume opto board did not reach the start or the stop position within a specified time!	1. Try cleaning (to remove clog). 2. Check the proper operation of the volume opto board and the float (opto switches, float, float house). 3. Check the fittings and the tubes around the volume opto board.
1105	Vacuum error	The measuring vacuum has been dramatically	Leakage in the pneumatic system (check the pump, fittings, tubings, pressure sensor, puffer reservoir

		decreasing during the measurement or absolutely lost!	and valves).
1106	%s - Fatal pneumatical error: %s CMD: %u(%u) Power off the system!	Fatal system error, PIC “called back”!	Check the proper operation of the motor modules (home/end opto switches, ribbon cables and the motor moving).
1107	Check Cleaner container!	Cleaner reagent container become empty, or the dil./clean fluid sensor is too sensitive or there are lot of bubbles in the cleaner tubes!	Replace the Cleaner reagent container with a filled one. If this still a problem with a filled cleaner reagent container, reset the sensitivity of the dil./clean sensor and check the tubings and the fittings.
1200	Fatal MeasInit error. Power off the system!	Fatal MPNIF error.	Replace the MPNIF board.
1201	Fatal HGB error. Power off the system!	HGB channel did not give a ready signal!	Replace the MPNIF board.
1300	Cannot write archive data! Check disk! It may be unformatted, full or bad! Do you want to retry?	Cannot write archive data because some disk errors!	Change the floppy disk.
1301	Cannot read archive data! Do you want to retry?	Archive disk is damaged or not an archive disk!	Change the floppy disk (archive).
1302	Cannot load archive data.	Disk is not an archive disk or damaged!	Change the floppy disk (archive).
1400	Printer error %d	Printer error!	Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu.
1401	Printer is out of paper and error %d	Printer is out of paper and there are some other printer errors!	Feed the printer with paper. Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu.
1402	Printer is out of paper	Printer is out of paper!	Feed the printer with paper.
1403	Printer was not set up correctly	The selected printer type does not match to the printer!	Modify the printer setup in the Settings/Printer settings sub-menu.
1404	Paper width is too large	Paper width overstep the margin.	Modify the paper setup in the Settings/Printer settings sub-menu.
1405	Paper height is too large	Paper height overstep the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.

1406	Paper width is too small	Paper width overstep the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.
1407	Paper height is too small	Paper height overstep the margin!	Modify the paper setup in the Settings/Printer settings sub-menu.
1408	Left margin is too large	Left margin is too large!	Modify the margin setup in the Settings/Printer settings sub-menu.
1409	Top margin is too large	Top margin is too large!	Modify the margin setup in the Settings/Printer settings sub-menu.
1410	Spacing is too large	The distance between two results is too high!	Modify the vertical spacing setup in the Settings/Printer settings submenu.
1411	Error #%d in printer initialization!	Printer software error!	Check the connections between the instrument and the printer and check the printer setup in the Settings/Printer settings sub-menu. Try to make a software upgrade.
1900	You have to add at least one user to use multi user mode!	Multi user problem.	Follow the instruction, or change to single user mode in the User settings submenu.

6.7.2. Message code list

Code	Message text
5000	Are you sure to prepare the device to delivery?
5001	Remove reagent tubing at rear reagent inputs (Diluent, Lyse, and Cleaner).
5002	Connect min. 100 ml distilled water to reagent inputs using cleaning tube kit.
5003	Remove cleaning tube kit. Keep reagent inputs free.
5004	You can power off the system!
5005	Apertures are partially clogged. Try cleaning!
5006	Please empty waste container!
5100	%u data record(s) will be copied to the database.
5101	%u data record(s) is selected.
5102	Insert data disk!
5103	Insert data disk #%d of %d!
5104	%u data record(s) will be saved on %d disk(s). Insert an empty floppy disk!
5105	Insert next empty floppy disk!
5106	No such type of data
5200	Your previous QC data will be lost. Are you sure?
5300	Some or all of the calibration factors are out of range!
5900	This function is not available because there are no accepted blank values. Try blank measurement!
5901	Insert software update disk! The system will restart.
5902	Are you sure to delete all device statistics?
5903	This function will delete all measured results. Are you sure?
5904	This function will delete all selected records. Are you sure?
5905	Are you sure?

6.8. Other problems

In this section we try to show some examples and troubleshooting of common problems from our first hand experience.

Problem	Possible reason	Remedy
WBC blank measurement error, C, B warning flags displayed, but the WBC histogram is correct (no noise).	The instrument measures the probe voltages for both apertures during the measurements. From these values (and from the measuring times) the analyzer can detect the clogging (C,c warning flags). If the WBC probe voltage is changed, the instrument will give a C warning flag, and the WBC value will have an E (error) flag. This fluctuation of the probe voltage can happen if the diluent reagent temperature is changed or there is a passage of the measuring current next to the aperture. For example the glue that fixes the aperture to the cellcounter probe is not consistent enough or the WBC chamber is damaged.	⇨ Change the WBC measuring tube (aperture). If the problem is in the inconsistent fixing glue, the problem will be solved. ⇨ Check the WBC chamber and replace it, if it is damaged.
There is no backlight in the LCD Module.	If the LCD is blank, and the Self test shows electrode voltage and current is low, there is no high voltage in the system. The problem is that the inverter circuit that generates this high voltage is out of order, or there is no connection between the MPU-Amplifier-High Voltage boards. The high voltage board contains a fuse (500 mA). If this fuse is burnt, the instrument will not have high voltage, LCD backlight, measuring current and high voltage burning pulses for the aperture cleaning. In that case the analyzer cannot perform measurements (no measuring current).	⇨ Check the 34-pin and the 20-pin ribbon cables between the MPNIF – Amplifier – High Voltage boards. Reconnect if you find something loose. ⇨ Dismount the Graphic LCD Module. Find the fuse on the inverter board. Check it, if it is burnt, please replace it or use a thin wire and short-circuit it using soldering iron.
Every measured parameter is zero (0), only HGB result is correct.	The shielded cable that connects the MPNIF board to the Amplifier board is disconnected. In that case only the measured HGB value is available, because it comes through the ribbon cable.	⇨ Reconnect the shielded cable at both ends (MPNIF, Amplifier).
The instrument always exits from the measurement with “Timeout occured” error. In the Self test almost every parameter is erroneous.	If the CPU cooling fan is not connected well on the CPU, the processor will overheat and in that case some type of mainboards (Sector) will decrease the clock frequency, which will make the program much slower and the instrument cannot detect the start position of the volume opto board. Other mainboards will stop the program. The volume meter tube is not in lowest point.	⇨ Check the CPU cooling fan to be well placed on the CPU, adjust if necessary. ⇨ Replace the CPU cooling fan if it is not working correctly. ⇨ Move the tube to the lowest position.

The peristaltic pump (the earlier type – see *Pump* section in this manual) slips and cannot drive the 3 white driving wheels.	If there is some dirt on the driving shaft, the pump cannot drive the wheels and cannot make vacuum for draining or for measurements. That is why one of the weekly maintenance should be done by User is the cleaning of the peristaltic pump driving shaft.	⇨ Replace or clean the peristaltic pump head as it is written in the Service Manual (7.2.3. section). ⇨ If it is not enough, replace the pump motor also.
WBC noise during measurements (blank and normal). Noise in the WBC histogram, S warning flag.	1. If there is not a good grounding in the system, the instrument can give such kind of errors. **Abacus/Arcus** has a shock protecting system that requires earth grounding. You must not operate the system without grounding. 2. These kind of errors can happen also if some other instruments (X-ray, monitor) are working near the instrument by making strong radiation, or from the same electrical outlet by generating fluctuation in the line, which causes the same problems. 3. Some extreme conditions (other reagent systems); this problem can happen with good grounding as well. In that case the blood samples make a thin fluidic film in the WBC draining tube (lipids + lysing reagent). This fluidic film conducts the noise to the WBC measuring electrode. To prevent the system from this problem, we recommend to use the built-in Autoclean procedure, which cleans up the fluidic film from the WBC draining tube with the cleaner reagent after every Xth measurement. The default value for the Autoclean cycles is 20 and it can be changed only from the service menu (see Section 5.2.8).	⇨ Measure grounding quality with a voltage meter by measuring AC voltage between grounding and neutral. This voltage must be less than 1 Volt. If the mains outlet does not provide a good ground, you can make it by connecting **Abacus/Arcus** to a grounded conductor i.e. water tap, or other grounded piping. ⇨ If it is possible, find another place for Abacus / Arcus, which is not near the other instruments. Use your analyzer with an individual outlet or use line filters. ⇨ You should lower the Autoclean setting to 10 or 5.

7. MAINTENANCE

7.1. Weekly Maintenance by User

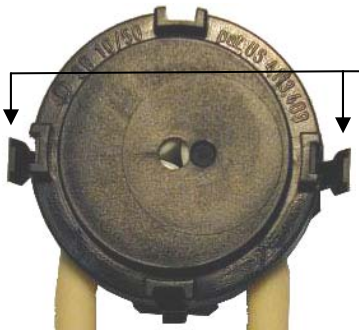
Weekly maintenance should be done by User on the first workday, before starting up the analyzer.

7.1.1. Cleaning washing head

User should clean the lower surface of the aspirating tip washing head using a soft cloth, immersed in warm tap water to remove salt build-up.

7.1.2. Cleaning peristaltic pump driving shaft

Only for the earlier pump type – see the *Pump* section of this Manual



1. Open the side door
2. Press together the 2 levers of the pump rotor by fingers so that you can pull out the whole pump head
3. Clean the motor shaft using a soft cloth immersed in alcohol
4. Securely push back the pump head in place until you hear a click

7.2. Periodic Maintenance by Service

The instruments should be checked and maintenance must be carried out in every 6 month.

7.2.1. Check Self test and Device statistics

Run the built-in Self test and check the overall test result. Check the device statistics to find the common problems.

7.2.2. Cleaning and Greasing Dilutor Block

The dilutor block driving wheels and gear bar should be cleaned from dirt and must be greased between the gear bar and the support, and between cogged wheels.

7.2.3. Cleaning and Lubricating Needle Moving Mechanics

The H&V moving mechanics sliding bars should be cleaned from dust.

Lubricating of the sliding bars must be made using „photorube" oil that contain teflon (PTFE). **Grease or pure lubricating oil is not suitable.**

7.2.4. Replacing or Cleaning Peristaltic Pump Head

Replace peristaltic pump head or tube if needed. You can check it by removing and disassembling the head. Check for leakage of the tubing. Clean the 3 white driving wheels and the driving shaft of the earlier type of pump if they are dirty using alcohol. Reassemble the head.

Warning! Be careful not to twist the tube while reposition it into the head, because it will cause malfunction in a very short period of time.

8. SPARE PARTS

In this section the spare parts are listed for Abacus and for Arcus. The New Dilutor will be available after SN 801420 for Abacus instruments

UNIT	CODE	Abacus	Arcus	NAME
MPNIF	A160	●	●	MPNIF card with controllers & SW(complete)
DISPLAY	A130	●		Abacus front panel
	C130		●	Arcus front panel
	A131	●		Front panel (complete without foil keyboard)
	A132	●		Abacus foil keyboard
	C132		●	Arcus foil keyboard
	A136	●	●	LMG7400PLFC graphic LCD module
HVB	A133	●	●	HVB (High Voltage Board) with inverter
	A134	●	●	HVB without inverter
	A135	●	●	INCV191 inverter board
AMP	A140	●		Abacus amplifier board (complete)
	C140		●	Arcus amplifier board (complete)
PC	A150	●	●	PC (mounted)
	A151	●	●	586 PC Mainboard
	A152	●	●	CPU chip
	A153	●	●	Fan for CPU
	A154	●	●	Floppy disk drive
	A156	●	●	Switching power supply
	A157	●	●	Mains switch
	A158	●	●	16 M RAM (minimum)
	A159	●	●	Loudspeaker
DILUTOR	A200	●	●	Dilutor block (complete)
	A201	●	●	Dilutor syringe
	A202	●	●	Macro piston
	A203	●	●	Lyse piston
	A204	●	●	Sealing ring for micro piston

UNIT	CODE	Abacus	Arcus	NAME
	A205	●	●	Micro piston
	A206	●	●	Cone for macro/micro syringe
	A207	●	●	Cone for lyse syringe
	A208	●	●	Gear stick
	A209	●	●	Gear (for dilutor syringe)
	A210	●	●	Gear (for dilutor motor)
	A211	●	●	Gear stick holder
	A212	●	●	Piston holder (plastic)
	A213	●	●	Opto flag (for dilutor block)
	A214	●	●	Dilutor opto board (mounted)
NEW Dilutor	S200	●	●	Dilutor board (complete)
	S201	●	●	Macro syringe (glass with connector)
	S202	●	●	Lyse syringe (glass with connector)
	S203	●	●	Micro syringe (plexiglass)
	S204	●	●	Micro piston (stainless steel)
	S205	●	●	Micro piston sealing part (teflon)
	S206	●	●	Macro piston (teflon)
	S207	●	●	Lyse piston (teflon)
	S208	●	●	Syringe block (3 syringes with holding parts)
	S209	●	●	Track (bearing guide)
	S210	●	●	Bearing for dilutor
	S211	●	●	Seeger ring (to fix bearings)
	S214	●	●	Dilutor opto board (mounted)
XY BLOCK	A300	●	●	XY movement block (complete)
	A301	●	●	Timing belt (for XY block)
	A302	●	●	Stepper motor
	A303	●	●	Bearing (for XY block)
	A304	●	●	Timing pulley for X
	A305	●	●	Timing pulley for Y
	A306	●	●	Gear for Y opto
	A307	●	●	H&V motor opto board (complete)
	A308	●	●	Opto switch for H&V board (GPIA51HR)
	A309	●	●	Opto switch for others (GPIA52HR)
	A310	●	●	Washing head

UNIT	CODE	Abacus	Arcus	NAME
	A311	●	●	Aspirator tip
	A312	●	●	Metal tube for washing head
MEAS	A400	●		Meas. block (complete)
	C400		●	Meas. block (complete)
	A401	●		Cone for chambers
	A402	●	●	Sealing ring for chambers
	A403	●	●	U-shaped metal fixing for apertures
	A404	●	●	WBC lower cone (teflon)
	A405	●	●	Shield
MIX	A410	●		MIX chamber (complete)
RBC	A420	●		RBC chamber (complete)
	A421	●		RBC measuring tube (aperture size: 80 µm)
	A422	●	●	Ground electrode for RBC/WBC
WBC	A430	●	●	WBC chamber (complete)
	A431	●		WBC measuring tube (aperture size: 100 µm)
	A433	●		Upper cone for WBC chamber
HGB	A434	●	●	HGB head (complete)
VMOP	A440			VMOP volume opto board (complete incl. tube)
	A441			VMOP volume opto board
	A442	●		Volume limiter tube (complete)
VALVES	A501	●		Valve unit I. (complete) (valve 1-5)
	A502	●		Valve unit II. (complete)(valve 6-10)
	A503	●		Valve unit III. (complete)(valve 11-15)
	C501		●	Valve unit I. (complete, valve 1-5)
	C503		●	Valve unit II. (complete, valve 11-15)
	A504	●	●	Valve 2/2 (two way valve complete)
	A505	●	●	Valve 3/2 (three way valve complete)
	A506	●	●	Valve coil for both valves
	A507	●	●	Valve head for 2/2 (two way valve)
	A508	●	●	Valve head for 3/2 (three way valve)
PUFFER	A510	●		Abacus Puffer reservoir
	C510		●	Arcus puffer reservoir
	A511	●	●	Puffer reservoir holder (pair)
PUMP	A520	●	●	Peristaltic pump (complete)
	A521	●	●	Cassette for peristaltic pump

UNIT	CODE	Abacus	Arcus	NAME
PRESS	A530	●	●	PCPRO pressure board (complete)
	A531	●	●	Pressure sensor
	A532	●	●	Reagent sensor tube for PCPRO board
TUBE	A541	●	●	Tube (for others) (1m) 4/2
	A544	●	●	Reagent tube (1m) 5/3
	A545	●	●	T connector
	A546	●	●	Y connector
	A547	●	●	3,2/3,2 Tube connector
	A548	●	●	O ring for WBC chamber
	A549	●	●	O ring for apertures
CONN.	A551	●	●	Reagent connector color locking ring
	A552	●	●	Reagent connector color lock nut (inside)
	A553	●	●	Reagent connector color coding ring (outside)
	A554	●	●	Reagent connector luer female
	A555	●	●	Reagent connector luer male
BODY	A600	●		Body (mounted)
	A610	●	●	Micro switch for start button
	A611	●	●	Sampling bar (start key)
	A612	●		Gloving LED cover (plastic)
	C612		●	Gloving LED cover (plastic)
	A613	●	●	Gloving LED board
	A620	●		Instrument door
	C620		●	Instrument door
	A621	●		Joint-hinge for instrument door (lower)
	A622	●		Joint-hinge for instrument door (upper)
	C621		●	Joint-hinge for instrument door
	A623	●	●	Magnet for door
	C624		●	Body cover
	A630	●		Upper body cover (plastic)
	C630		●	Plastic front body
	A640	●	●	Instrument foot
CABLES	A701	●	●	Mains cable
	A702	●	●	Printer cable
	A703	●	●	Serial cable
	A712	●		X motor cable

UNIT	CODE	Abacus	Arcus	NAME
	A713	●		Y motor cable
	A714	●		Dilutor cable
	A715	●		Keyboard cable
CABLES	A716	●		LCD cable
	A717	●		Valve I. (1-5) cable
	A718	●		Valve II. (6-10) cable
	A719	●		Valve III. (11-15) cable
	A720	●		Pressure & Liquid sensor board cable
	A721	●		Amplifier board cable I.
	A722	●		Amplifier board cable II. (1 wire)
	A723	●		HVB board cable
	C712		●	X motor cable
	C713		●	Y motor cable
	C714		●	Dilutor cable
	C715		●	Keyboard cable
	C716		●	LCD cable
	C717		●	Valve I. (1-5) cable
	C719		●	Valve III. (11-15) cable
	C720		●	Pressure board cable
	C721		●	Amplifier board cable I.
	C722		●	Amplifier board cable II. (1 wire)
	C723		●	HVB board cable

Addendum to existing Spare part list of Abacus/Arcus for new MB4 motherboard:

UNIT	CODE	Abacus	Arcus	NAME
New mother board	A600081	●		Abacus MB4 motherboard holding plate
	C600121		●	Arcus MB4 motherboard holding plate
	AC60099	●	●	Connector holding plate
	AC60098	●	●	DimmPC safe ring
	AC1511	●	●	MB4 motherboard (without DimmPC)
	AC1512	●	●	DimmPC (CPU)
	AC1513	●	●	COMS&KEY connector PCB
	AC1514	●	●	COMS&KEY ribbon cable
	AC1515	●	●	LPT&USB connector PCB
	AC1516	●	●	LPT&USB ribbon cable
	A1510	●		Abacus MB4 upgrade kit
	C1510		●	Arcus MB4 upgrade kit

9. APPENDICES

9.1. Warning flags

Flag	Meaning	Recommended user action
W	WBC three part warning or WBC three part diff. unsuccessful	⇒ Repeat the measurement. Possibly lyse problem. ⇒ Check the discriminators in the WBC histogram. If the discriminators are in the proper place (the populations can be separated by eye) then the results are correct.
E	No WBC three part	⇒ Possibly lyse problem, but in some pathological samples (too high lymphocytes), it can be happened.
H	HGB blank is high, or no HGB blank	⇒ Repeat the blank measurement and accept it. ⇒ Possibly lyse or diluent problem.
B	WBC blank is high, or no WBC blank	⇒ Repeat the blank measurement and accept it. ⇒ Possibly lyse or diluent or noise problem.
L	WBC/RBC limit warning	⇒ Check the 1. RBC-LYM discriminator. If it is in the minimum point (or close to it), accept the results. Otherwise repeat the measurement. ⇒ If the retried action makes very similar results and the discriminator is in a wrong place then the MID and GRA results are OK, but the WBC and LYM results can be higher because of the RBCs.
R	Too many RBC cut from WBC	⇒ Repeat the measurement. Possibly lyse problem. ⇒ If the WBC measuring time is too high (more than 8 sec.) it could be aperture clogging. In that case perform cleaning and repeat the measurement.
M	WBC coincidence is too high. Linearity error.	⇒ The results are out of the linearity range. Make a dilution with an external dilutor with a pre-defined dilution range. Do not forget to correct the results with the defined factor.
D	WBC data package errors	⇒ Perform cleaning and repeat the measurement (aperture clogging). ⇒ If it is a general problem, please call your Service Personnel.
S	WBC time error	⇒ The same action as in case of the **D** warning flag.
C	WBC clogging	⇒ Aperture clogging. The same action as in case of the **D** warning flag.
p	PLT blank is high, or no PLT blank	⇒ Repeat the blank measurement and accept it. ⇒ Diluent problem. Replace diluent, open a new tank.
b	RBC blank is high, or no RBC blank	⇒ Repeat the blank measurement and accept it. ⇒ Diluent problem. Replace diluent, open a new tank.
l	RBC/PLT limit warning	⇒ The RBC/PLT valley is too high. It is rather a diagnostic flag. If the discriminator is in a wrong place (in the PLT or RBC histogram) then repeat the measurement for a correct PLT result.
k	RBC peak warning	⇒ Perform cleaning and repeat the measurement (clogging). ⇒ If it is a general problem, change the RBC aperture.
m	RBC/PLT coincidence is too high. Linearity error.	⇒ The same action as in case of the **M** warning flag.
d	RBC/PLT data package errors	⇒ The same action as in case of the **D** warning flag.
s	RBC/PLT time error	⇒ The same action as in case of the **D** warning flag.
c	RBC/PLT clogging	⇒ The same action as in case of the **C** warning flag.

9.2. Serial Communication Protocol (V1.7 & 2.x)

General Description

The Abacus/Arcus software is able to make serial connection link to a receiver device (e.g. computer) which is connected to the serial port. If the Baud Rate setting in the Service Menu is set to a valid value (other than Not Connected), the instrument will try to initiate a communication sequence.

The serial communication is always initiated by Abacus/Arcus, and the receiver must respond to this.

The hardware protocol: **8 data bit, 1 stop bit, no parity**. If the other side is not responding in 1 second, the instrument will repeat the transmission twice, but if still no response, the other side will be supposed to be not ready to receive data, and thus Abacus/Arcus will not try to communicate any more.

From this state it can wake up by receiving an <ENQ> (ASCII code 5) character from the other side, and the instrument will immediately respond an <ACK> (ASCII code 6). From this point the instrument will send data if it is ready for transmission.

The communication is based on packages. There are 5 package types:

- INIT package: Device identification, software version, current date and time.
- DATA package: Sample and patient information, measured parameters, and markers.
- RBC package: Sample information, RBC histogram.
- WBC package: Sample information, WBC histogram.
- PLT package: Sample information, PLT histogram.

The communication sequence is always started with an INIT package. If the link is successful, the instrument will send DATA package, and the receiver can request RBC, WBC and PLT packages at acknowledge.

Special characters used in the communication:

Character	ASCII code
<SOH>	1
<STX>	2
<ETX>	3
<EOT>	4
<ENQ>	5
<ACK>	6
<HT>	9
<LF>	10
<NAK>	21
<SPACE>	32

Format of Packages Sent by Abacus/Arcus

The packages sent by Abacus/Arcus are always between a <SOH> and <EOT> character, and they consist of header, data and tail. The header consists of a package identifier and a package type descriptor. The tail includes the checksum. Typical format:

<SOH>MID CMD**<STX>**MESSAGE**<ETX>**CHKSUM**<EOT>**

MID: Message ID, one capital letter between 'A' and 'Z'

CMD: Command, one capital letter, package type descriptor

- 'I' for INIT;
- 'D' for DATA;
- 'R' for RBC;
- 'W' for WBC;
- 'P' for PLT.

MESSAGE: the message consists of ASCII characters (between 32..128)

CHKSUM: two hexadecimal digits of a one-byte checksum which contains the lower byte of the sum of characters between the <SOH> and <ETX> (incl. those, too).

Format of Acknowledge of the Receiver

The receiver must acknowledge transmission by the following message:

<ACK>CMD MID

CMD: the type of the next package to send – this makes possible to a request for histograms. If no more packages are required, <SPACE> should be sent.

MID: the identifier of the package that acknowledged by this message.

If receiving of the message was not successful, <NAK> should be sent, and Abacus/Arcus will repeat the last package.

The receiver has approx. 1 second to reply, otherwise Abacus/Arcus will repeat the last transmission, twice automatically. But if still no response after 3 trials, Abacus/Arcus will not start to communicate any more, even if there is data to send (see General Description).

Detailed Description of Packages

The packages sent by Abacus/Arcus are placed between a header and a tail. There are 3 main types of them: INIT, DATA and histogram packages. The histogram package can be: RBC, WBC, and PLT. Their format is the same, the type descriptor differs only.

INIT package

Abacus/Arcus sends the general identifiers by this package during initiation of a communication:

DEVICE**<HT>**VERSION**<HT>**DATE**<HT**>TIME

DEVICE: device identifier

VERSION: version of the software, e.g. „1.7"

DATE: date in YYYYMMDD format

TIME: time in HHMMSS format

DATA package

This package contains sample and patient data, the measured parameters and the markers of histograms. One data element consists of two items: name and value, which are separated by a <HT> character, and closed by <LF>.

Important! SNO, DATE, TIME, SID and PID fields will always be present in this order, but other fields may be omitted.

SNO**<HT>**152**<LF>**	internal identifier
DATE**<HT>**19980715**<LF>**	date of measurement (YYYYMMDD)
TIME**<HT>**114500**<LF>**	time of measurement (HHMMSS)
SID**<HT>**1AXX435**<LF>**	sample identifier (alphanumeric)
PID**<HT>**B72D44**<LF>**	patient identifier (alphanumeric)
NAME**<HT>**JOE SMITH**<LF>**	patient name (alphanumeric)
BIRTH**<HT>**19650208**<LF>**	birthdate of patient (YYYYMMDD)
SEX**<HT>**0**<LF>**	patient sex (0-male, 1-female)
DOC**<HT>**Dr John Gold**<LF>**	doctor's name
OPID**<HT>**1172**<LF>**	operator identifier (alphanumeric)
MODE**<HT>**0**<LF>**	patient type
WRN**<HT>**0**<LF>**	warning bits[1] (32-bit hexadecimal)
PM1**<HT>**12**<LF>**	PLT lower marker[2]
PM2**<HT>**204**<LF>**	PLT upper marker[2]
RM1**<HT>**51**<LF>**	RBC lower marker[2]
WM1**<HT>**23**<LF>**	WBC upper marker[2]
WM2**<HT>**57**<LF>**	WBC LYM-MID marker[2]
WM3**<HT>**92**<LF>**	WBC MID-GRA marker[2]
PARN**<HT>**22**<LF>**	number of parameters to send
P01**<HT>** 6.6**<HT>**0**<LF>**	first parameter ID[3], value and flag[4]
P02**<HT>**4.29**<HT>**0**<LF>**	second parameter ID, value and flag
...	
P22**<HT>** 8.2**<HT>**0**<LF>**	last parameter ID, value and flag

Remarks:

[1] Position and meaning of the warning flags:

Bit	Mask	Letter	Meaning
0	0x00001	c	RBC/PLT clogging.
1	0x00002	s	RBC/PLT time error.
2	0x00004	d	RBC/PLT data package errors.
3	0x00008	m	RBC/PLT coincidence is too high. Linearity error.
4	0x00010	k	RBC peek warning.
5	0x00020	l	RBC/PLT limit warning.
6	0x00040	b	RBC blank is high, or no RBC blank.
7	0x00080	p	PLT blank is high, or no PLT blank.
8	0x00100	C	WBC clogging.
9	0x00200	S	WBC time error.
10	0x00400	D	WBC data package errors.
11	0x00800	M	WBC coincidence is too high. Linearity error.

12	0x01000	R	Too many RBC cut from WBC.
13	0x02000	L	WBC/RBC limit warning.
14	0x04000	B	WBC blank is high, or no WBC blank.
15	0x08000	H	HGB blank is high, or no HGB blank.
16	0x10000	E	No WBC three part.
17	0x20000	W	WBC three part warning or WBC three part diff. unsuccessful.

[2] The markers are given in histogram channel between 0 and 255, where 0 means that the marker could not be found.

[3] The parameter IDs in Abacus/Arcus are: P01: WBC (10^9/l); P02: RBC (10^{12}/l); P03: HGB (g/l); P04: HCT (%); P05: MCV (fl); P06: MCH (pg); P07: MCHC (g/l); P08: PLT (10^9/l); P09: PCT (%); P10: MPV (fl); P11: PDWsd (fl); P12: PDWcv (%); P13: RDWsd (fl); P14: RDWcv (%); P15: LYM (10^9/l); P16: MID (10^9/l); P17: GRA (10^9/l); P18: LYM% (%); P19: MID% (%); P20: GRA% (%); P21: RBCtime (sec); P22: WBCtime (sec).

[4]The parameter value is always 4 character wide, spaces from left added if necessary. It can be 9999, if the value could not be displayed in 4 digits, or ---- if the value could not be calculated because of an error.

The meaning of the parameter flags:

Flag	Displayed	Meaning
0		Value correct.
1	+	Value high (more than upper limit)
2	–	Value low (less than lower limit)
3	*	Value is unreliable.
4	E	Value not given because of error. Value is ----.
5		Value cannot be calculated. There is no value!

RBC, WBC and PLT package

The format of the histogram packages are the same, they differ in type descriptor only. The package contains the sample data (to identify the package) and the histogram.

SNO**<HT>**152**<LF>**	internal identifier
DATE**<HT>**19980715**<LF>**	date of measurement (YYYYMMDD)
TIME**<HT>**114500**<LF>**	time of measurement (HHMMSS)
SID**<HT>**1AXX435**<LF>**	sample identifier (alphanumeric)
PID**<HT>**B72D44**<LF>**	patient identifier (alphanumeric)
CHN**<HT>**256**<LF>**	number of histogram channels (256)
9**<HT>**	value of first histogram channel
...	
1**<HT>**	value of 255th histogram channel
0	value of the last histogram channel

Example

Let us suppose that the receiver was not ready to receive when Abacus/Arcus was switched on, therefore the instrument is not starting a communication.

Receiver sends that it is ready to receive now, Abacus/Arcus sends acknowledge.

<ENQ>

<ACK>

Abacus/Arcus sends INIT next time to initiate link (there is data to send):

V1.7 software:

<SOH>AI<STX>DiaTron Abacus<HT>1.7g<HT>20010405<HT>163902<ETX>88<EOT>

V2.x software:

<SOH>AI<STX>Abacus<HT>2.15a<HT>20010405<HT>160734<ETX>E4<EOT>

Receiver sends acknowledge:

<ACK><SPACE>A

Abacus/Arcus sends DATA package:

<SOH>BD<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>
PID<HT><LF>NAME<HT><LF>BIRTH<HT>00000000<LF>SEX<HT>0<LF>DOC<HT><LF>OPID<H
T>0<LF>MODE<HT>0<LF>WRN<HT>0<LF>PM1<HT>10<LF>PM2<HT>135<LF>RM1<HT>34<LF>
WM1<HT>21<LF>WM2<HT>55<LF>WM3<HT>91<LF>PARN
<HT>22<LF>P01<HT>6.4<HT>0<LF>P02<HT>4.36<HT>0<LF>P03<HT>131<HT>0<LF>
P04<HT>39.0<HT>0<LF>P05<HT>90<HT>0<LF>P06<HT>30.0<HT>0<LF>P07<HT>335
<HT>0<LF>P08<HT>262<HT>0<LF>P09<HT>0.24<HT>0<LF>P10<HT>9.2<HT>0<LF>
P11<HT>12.0<HT>0<LF>P12<HT>36.9<HT>0<LF>P13<HT>52.3<HT>1<LF>P14<HT>
16.3<HT>0<LF>P15<HT>2.1<HT>0<LF>P16<HT>0.5<HT>0<LF>P17<HT>3.7<HT>0<LF>P18<HT>
33.4<HT>0<LF>P19<HT>7.8<HT>1<LF>P20<HT>58.8<HT>0<LF>P21<HT>
8.4<HT>0<LF>P22<HT> 5.0<HT>0<LF><ETX>89<EOT>

Receiver acknowledges DATA transmission, and requests for RBC package:

<ACK>RB

Abacus/Arcus sends RBC package:

<SOH>CR<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>
PID<HT>57290<LF>CHN<HT>256<LF>4<HT>9<HT>17<HT>27<HT>37<HT>48<HT>58<HT>66<H
T>70<HT>72<HT>70<HT>66<HT>60<HT>54<HT>47<HT>39<HT>33<HT>28<HT>22<HT>18<HT>1
5<HT>11<HT>9<HT>8<HT>7<HT>5<HT>4<HT>4<HT>3<HT>3<HT>2<HT>2<HT>1<HT>1<HT>0<
HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>
0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>1<HT>1<HT>1<HT>2<HT>2<HT>3<HT>4<HT>5<H
T>6<HT>7<HT>8<HT>9<HT>10<HT>11<HT>12<HT>14<HT>16<HT>18<HT>21<HT>24<HT>28<H
T>31<HT>35<HT>38<HT>43<HT>47<HT>53<HT>58<HT>65<HT>71<HT>78<HT>86<HT>94<HT>1
03<HT>113<HT>121<HT>130<HT>139<HT>149<HT>160<HT>171<HT>184<HT>196<HT>207<HT
>217<HT>225<HT>231<HT>237<HT>242<HT>245<HT>248<HT>251<HT>252<HT>253<HT>253<
HT>253<HT>253<HT>253<HT>254<HT>255<HT>254<HT>252<HT>248<HT>243<HT>236<HT>22
9<HT>221<HT>214<HT>207<HT>199<HT>192<HT>185<HT>178<HT>170<HT>162<HT>154<HT>
146<HT>137<HT>129<HT>121<HT>113<HT>104<HT>96<HT>88<HT>82<HT>75<HT>71<HT>66<
HT>62<HT>58<HT>55<HT>51<HT>47<HT>43<HT>38<HT>35<HT>31<HT>28<HT>25<HT>22<HT
>19<HT>18<HT>16<HT>14<HT>12<HT>11<HT>10<HT>9<HT>9<HT>9<HT>9<HT>8<HT>8<HT>7
<HT>7<HT>6<HT>6<HT>5<HT>5<HT>5<HT>4<HT>4<HT>3<HT>3<HT>3<HT>2<HT>2<HT>2<HT
>1<HT>1<HT>1<HT>1<HT>1<HT>1<HT>1<HT>2<HT>2<HT>2<HT>2<HT>2<HT>2<HT>2<HT>1<
HT>1<HT>1<HT>1<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>
0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<H
T>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<
HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<ETX>60<E
OT>

Receiver acknowledges RBC transmission, and requests for WBC package:

<ACK>WC

Abacus/Arcus sends WBC package:

<SOH>DW<STX>SNO<HT>1<LF>DATE<HT>20010405<LF>TIME<HT>163800<LF>SID<HT>1<LF>PID<HT>57290<LF>CHN<HT>256<LF>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>0<HT>255<HT>255<HT>255<HT>251<HT>209<HT>163<HT>118<HT>82<HT>56<HT>40<HT>32<HT>29<HT>29<HT>30<HT>34<HT>40<HT>47<HT>55<HT>64<HT>76<HT>88<HT>103<HT>119<HT>136<HT>155<HT>174<HT>195<HT>215<HT>233<HT>246<HT>254<HT>255<HT>249<HT>240<HT>227<HT>213<HT>200<HT>187<HT>176<HT>164<HT>153<HT>141<HT>129<HT>118<HT>108<HT>99<HT>92<HT>86<HT>81<HT>76<HT>71<HT>67<HT>64<HT>62<HT>61<HT>60<HT>60<HT>60<HT>57<HT>55<HT>51<HT>47<HT>44<HT>43<HT>42<HT>42<HT>43<HT>44<HT>45<HT>47<HT>47<HT>46<HT>45<HT>43<HT>40<HT>37<HT>34<HT>32<HT>30<HT>30<HT>30<HT>30<HT>29<HT>28<HT>26<HT>24<HT>21<HT>19<HT>17<HT>15<HT>14<HT>13<HT>12<HT>13<HT>13<HT>13<HT>13<HT>13<HT>12<HT>11<HT>11<HT>11<HT>12<HT>12<HT>14<HT>15<HT>16<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>17<HT>18<HT>19<HT>21<HT>22<HT>23<HT>24<HT>25<HT>25<HT>25<HT>26<HT>29<HT>31<HT>34<HT>35<HT>36<HT>36<HT>35<HT>35<HT>35<HT>37<HT>38<HT>41<HT>43<HT>46<HT>47<HT>48<HT>50<HT>52<HT>56<HT>60<HT>64<HT>70<HT>74<HT>79<HT>82<HT>86<HT>89<HT>92<HT>95<HT>99<HT>102<HT>103<HT>104<HT>105<HT>105<HT>106<HT>108<HT>110<HT>112<HT>115<HT>117<HT>119<HT>120<HT>121<HT>120<HT>120<HT>120<HT>121<HT>122<HT>125<HT>129<HT>132<HT>136<HT>139<HT>141<HT>142<HT>142<HT>140<HT>138<HT>135<HT>132<HT>129<HT>127<HT>125<HT>123<HT>122<HT>120<HT>117<HT>115<HT>112<HT>109<HT>108<HT>108<HT>109<HT>110<HT>110<HT>108<HT>104<HT>99<HT>94<HT>89<HT>85<HT>82<HT>80<HT>79<HT>78<HT>77<HT>75<HT>72<HT>68<HT>63<HT>58<HT>54<HT>50<HT>47<HT>44<HT>43<HT>41<HT>41<HT>42<HT>42<HT>42<HT>42<HT>39<HT>37<HT>34<HT>30<HT>28<HT>25<HT>24<HT>23<HT>22<HT>22<HT>21<HT>21<HT>19<HT>17<HT>13<HT>9<HT>5<ETX>F7<EOT>

Receiver acknowledges WBC transmission, and closes the link. It is possible to request for PLT histogram if the acknowledge contains a “P” instead of <SPACE>, but it is not shown in this example.

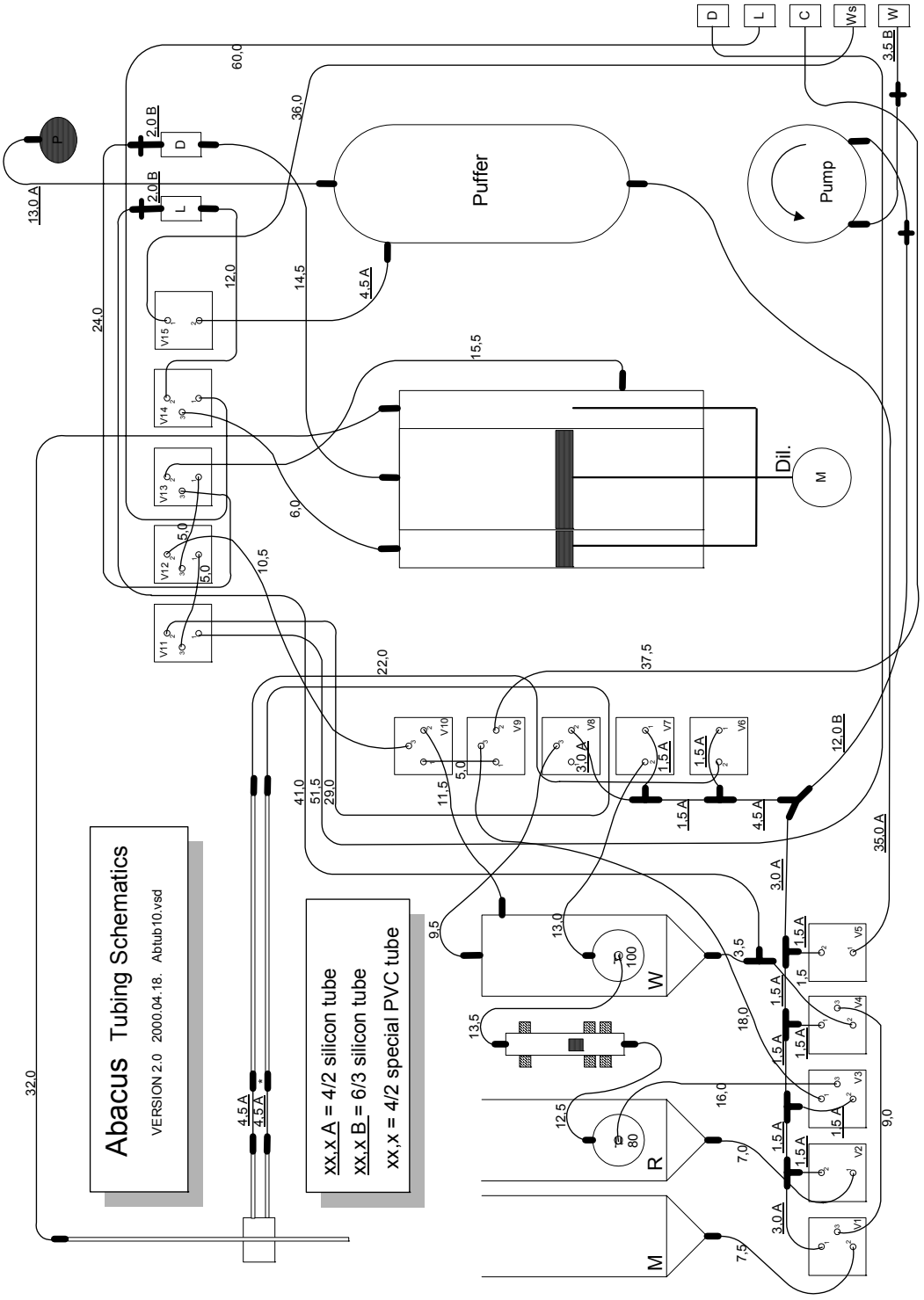
<ACK><SPACE>D

***

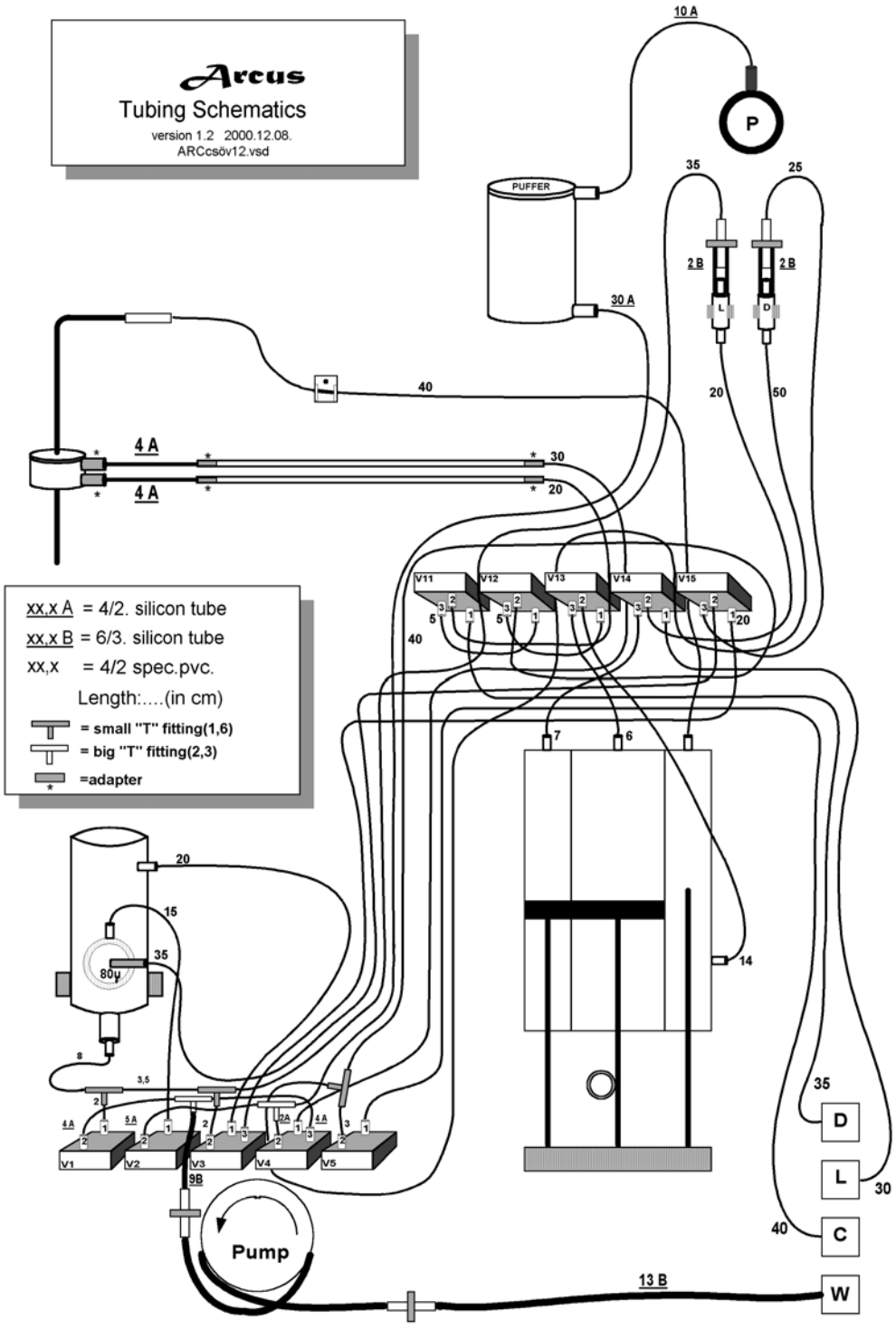
9.3. Recommended kit of tools

- PC standard keyboard
- Screwdrivers:
  - Cross Slot Screwdrivers (Philips)
  - Slot Screwdrivers
  - Hexagon Screwdrivers (3.5, 2.5, 2.0, 1.5 mm sizes)
- Pocket digital multimeter
- Diagonal Cutter (plier)
- Nipper

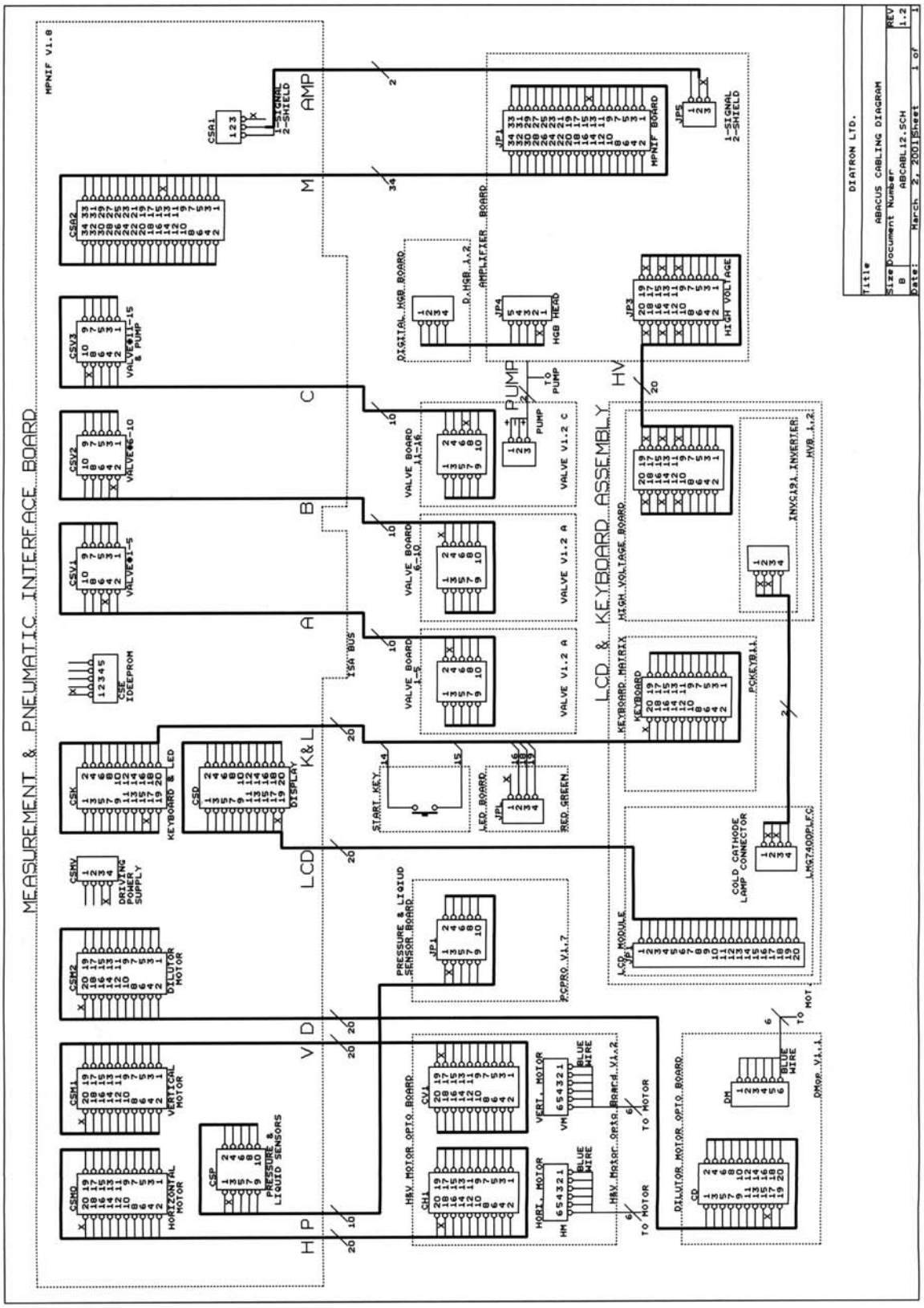
9.4. Abacus tubing schematic



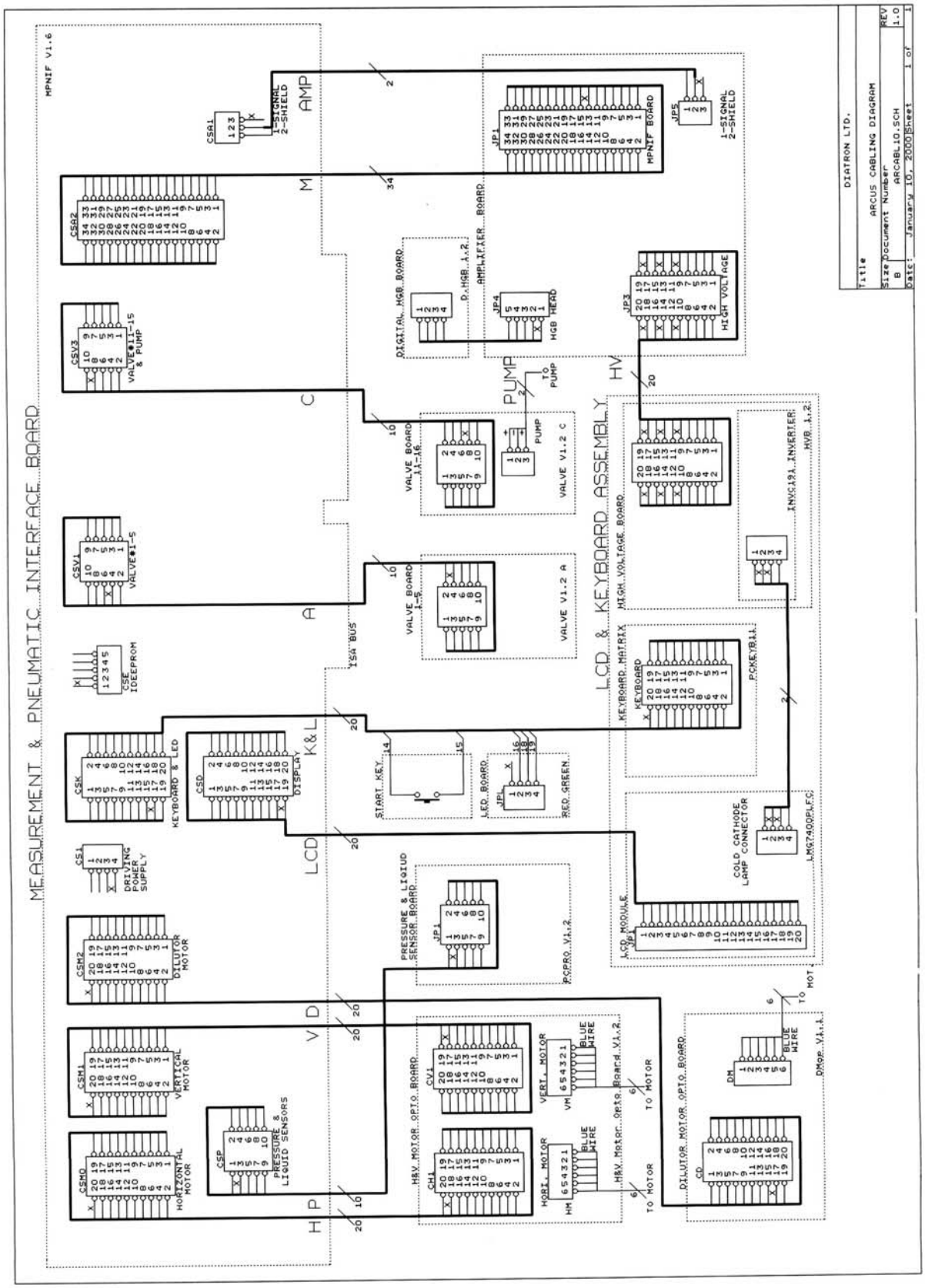
9.5. Arcus tubing schematic



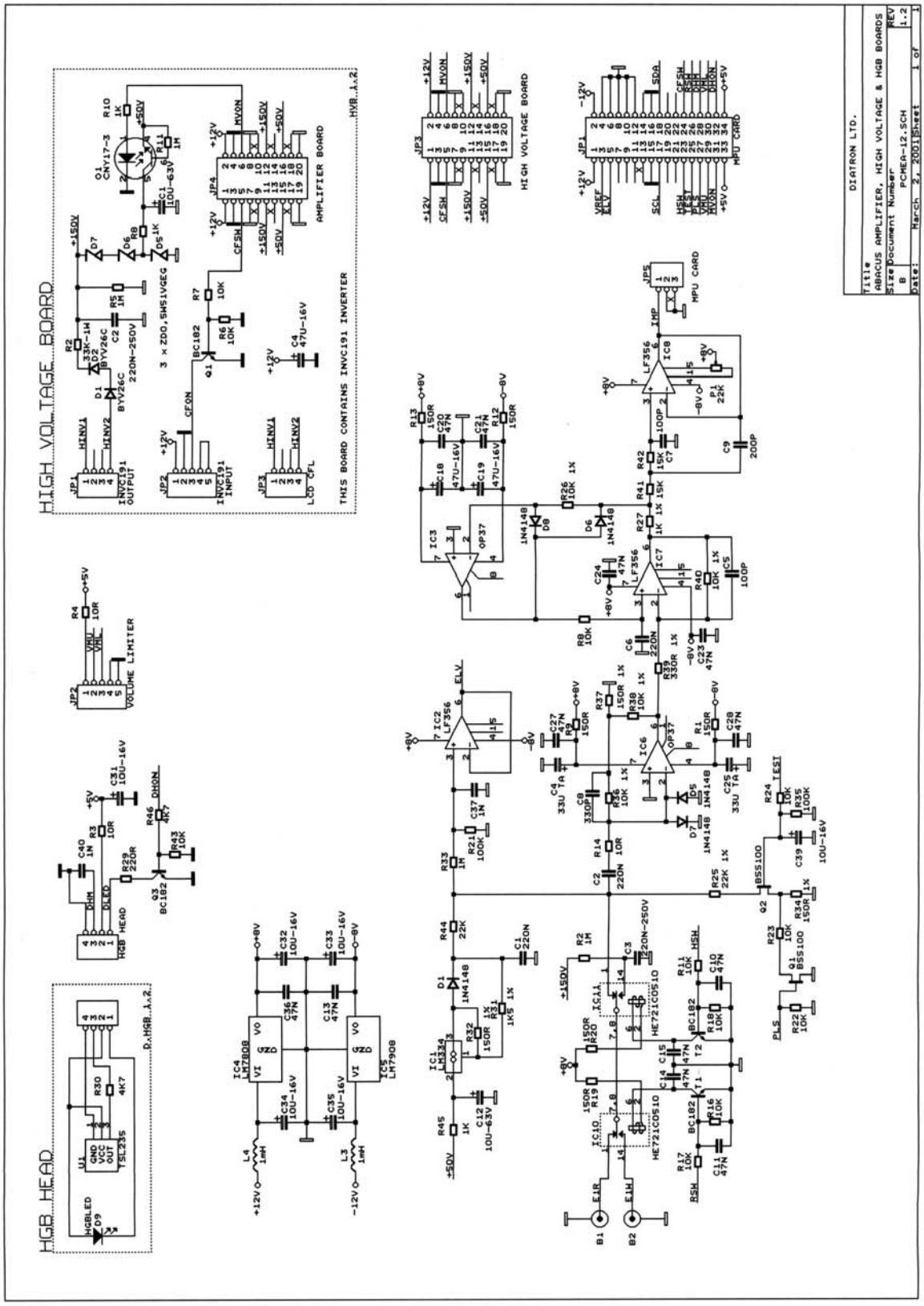
9.6. Abacus Cabling Diagram



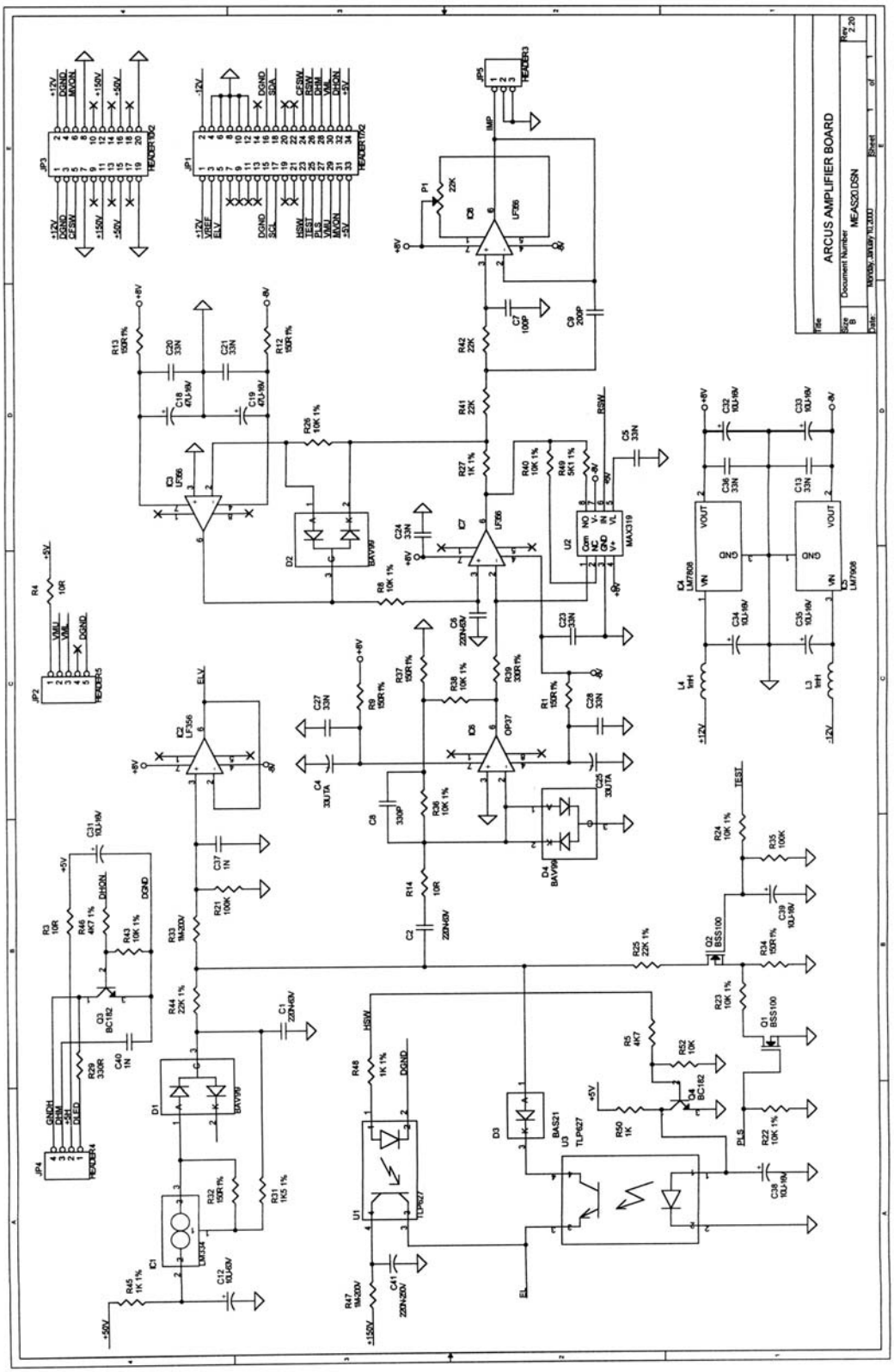
9.7. Arcus Cabling Diagram



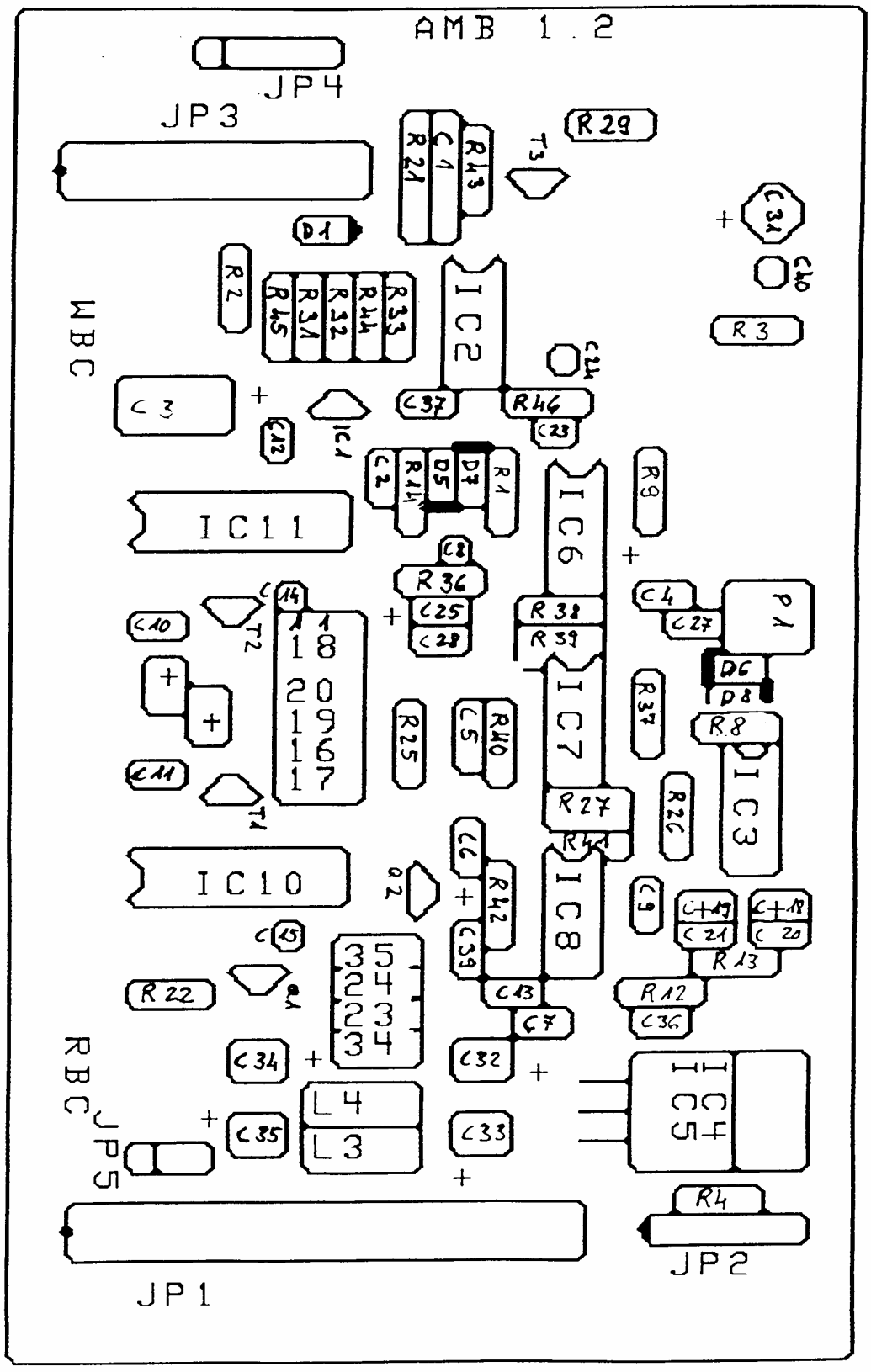
9.8. Abacus Amplifier, High voltage & HGB Boards



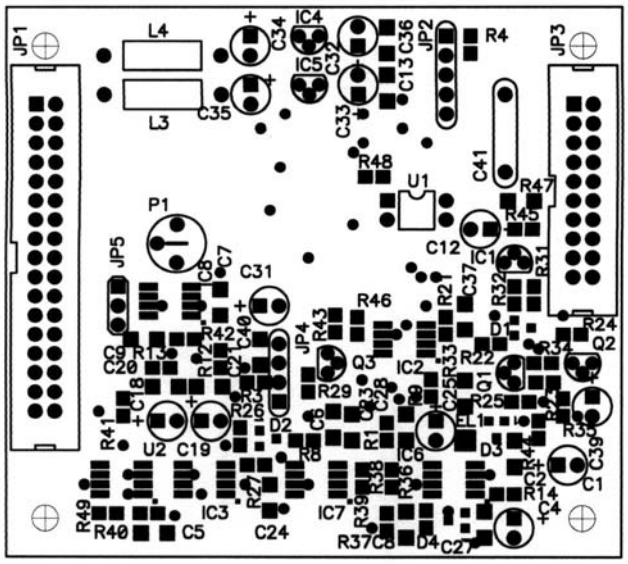
9.9. Arcus Amplifier



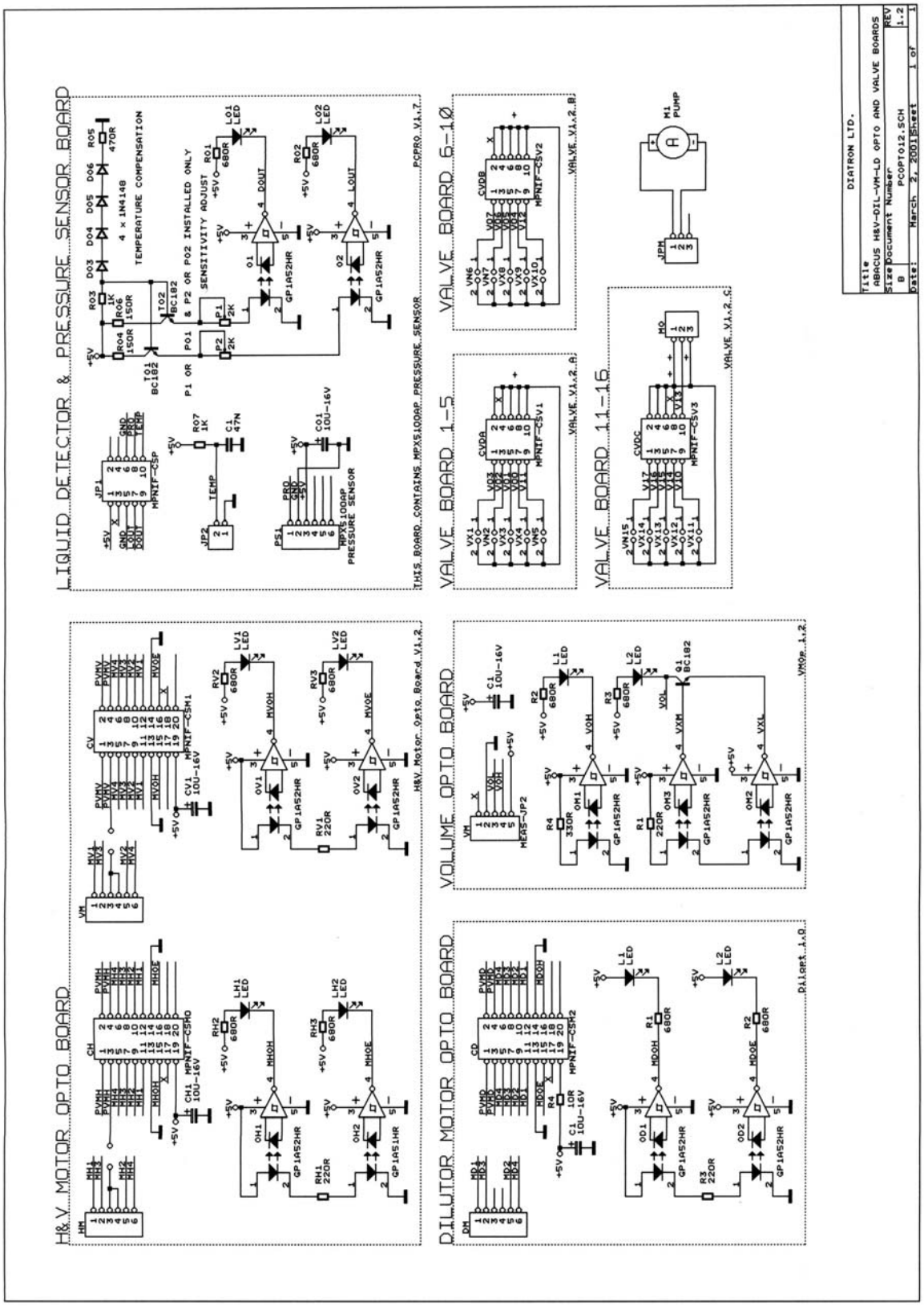
9.10. Abacus Amplifier PCB



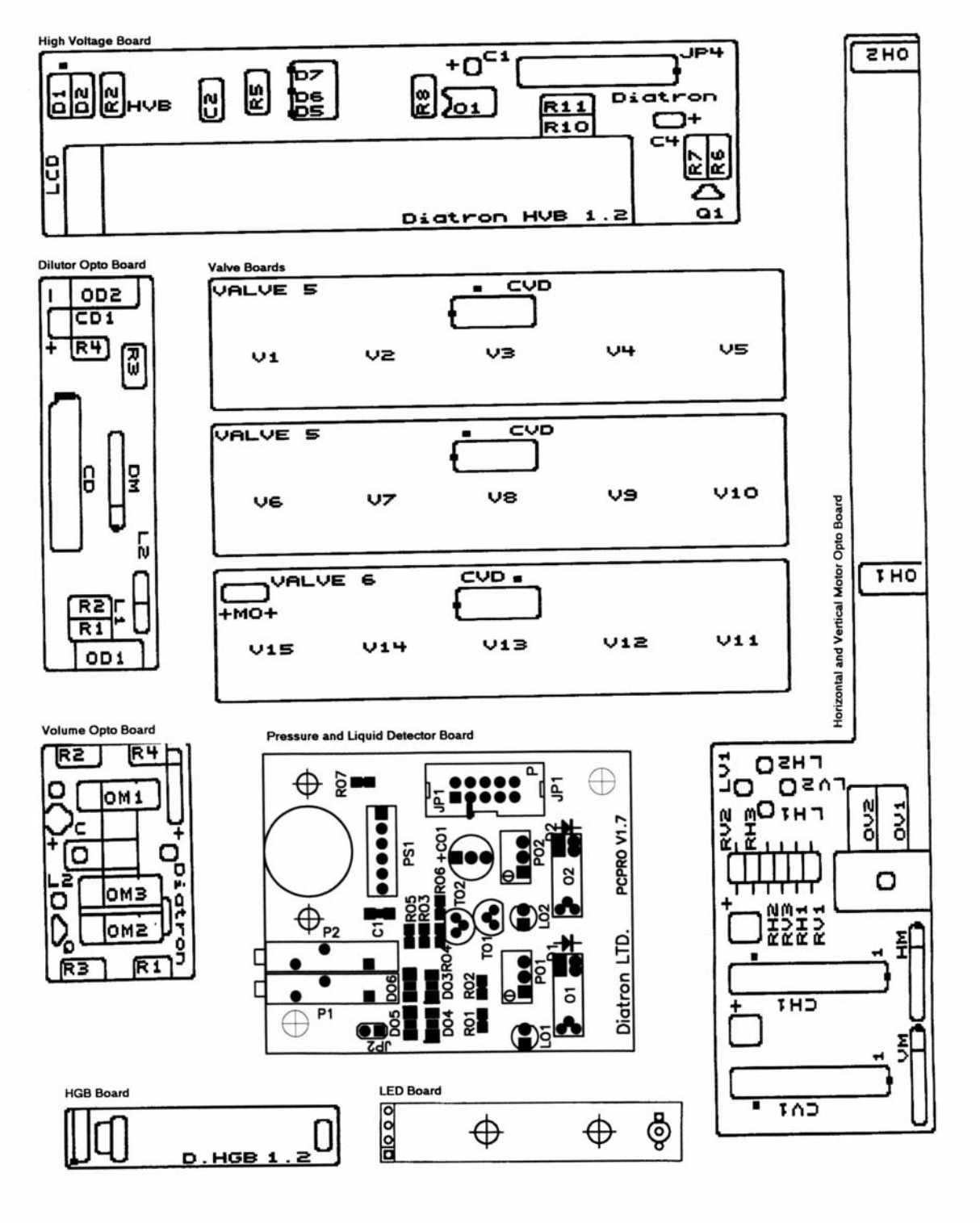
9.11. Arcus Amplifier PCB



9.12. H&V, DIL, VM, LD Opto and Valve Boards



9.13. Electronic part PCBs



10. ADDENDUM TO Abacus/Arcus Service Manual

DIMM-PC* based motherboard (MB4DIMM)

1. This section is an addendum to Service Manual Section 2.1.15.

Since original AT type main boards are no longer available on the market, we created a new motherboard named MB4DIMM. It includes a DIMM-PC core module (credit-card size PC). From now on, we will equip all existing models with MB4DIMM motherboards, and it will be used as substitute if you order spare parts as well.

The new motherboard runs SW version 2.6 or higher only. ***Do not forget to upgrade the software to at least SW version 2.6 if your system contains MB4DIMM.***

The DIMM-PC can be dismounted in the following way (see Figure 1.):

1. Discharge all electricity from your body by touching the instrument case before proceeding. Dimm-PC is very sensitive against electrostatic discharge.
2. Remove the safe lock screw (M2 x 10 mm, hexagonal).
3. Open the two white levers on both sides so that Dimm-PC flips up.
4. Pull out Dimm-PC module from the socket.

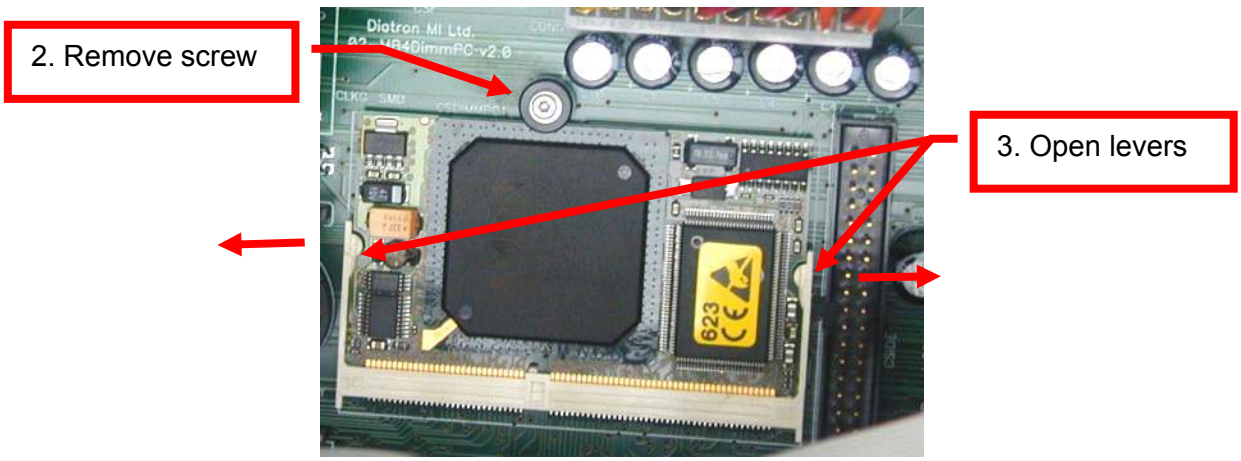


Figure 1. Dismounting of DIMM-PC

The DIMM-PC can be mounted to MB4DIMM in the following way:

1. Discharge all electricity from your body by touching the instrument case before proceeding. DimmPC is very sensitive against electrostatic discharge.
2. Place the DIMM-PC with edge connector to the socket with Elan chip up, at approx. 30° angle and push it softly into the socket. Do not to force it because the socket can be damaged. Pull apart the white holder on both sizes and snap the module into place by pushing it down.
3. Make sure the levers are back in place keeping the module down.
4. Screw in the safe lock screw with the plastic ring (M2 x 10 mm, hexagonal).

*DimmPC is the trade mark of Kontron Embedded Modules GmbH.

DIMM-PC has full PC functionality as shown below (see Figure 2.).

It includes Flash BIOS, system RAM, SanDisk (Flash disk), Real time clock, and super-I/O functions on board. It keeps BIOS data in a CMOS EEPROM, i.e. CMOS data is safe even in low battery conditions.

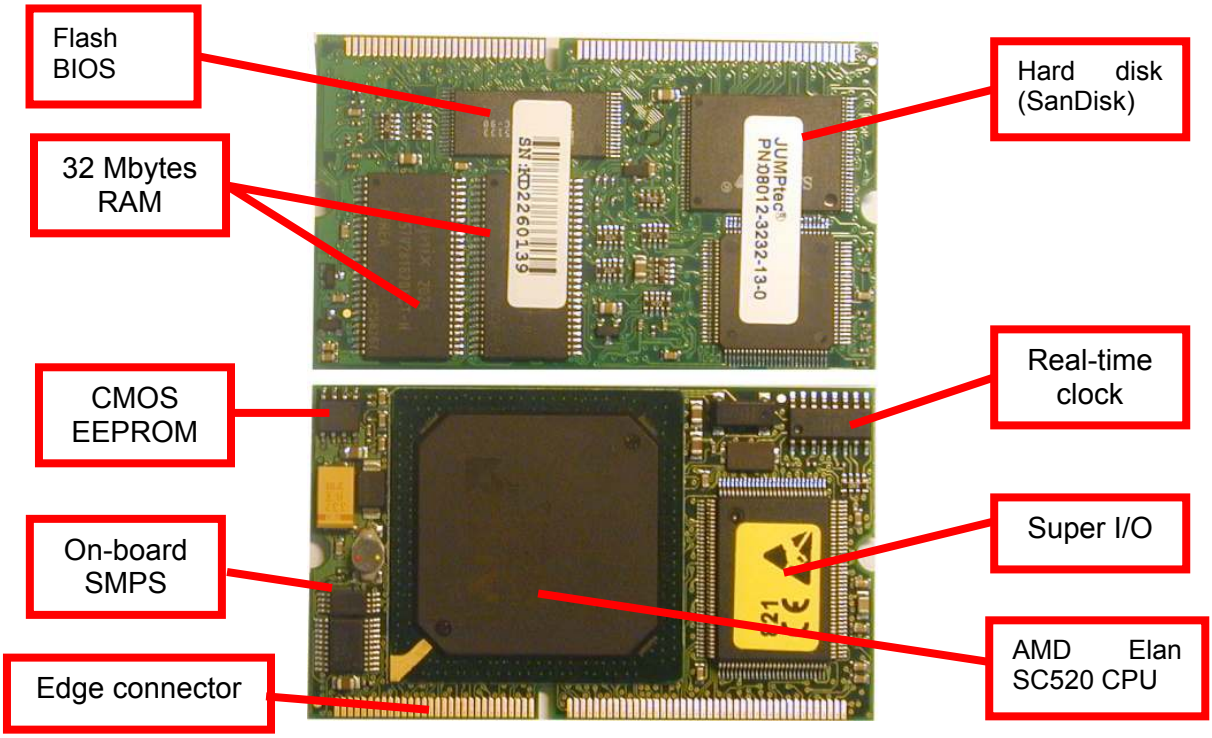


Figure 2. DIMM-PC components

The new peripheral connector assembly provides connection between MB4DIMM and external peripherals, like serial host, parallel printer, PS/2 keyboard. USB port is still not operational.

You should use this connector assembly if you upgrade your existing machine to MB4DIMM.

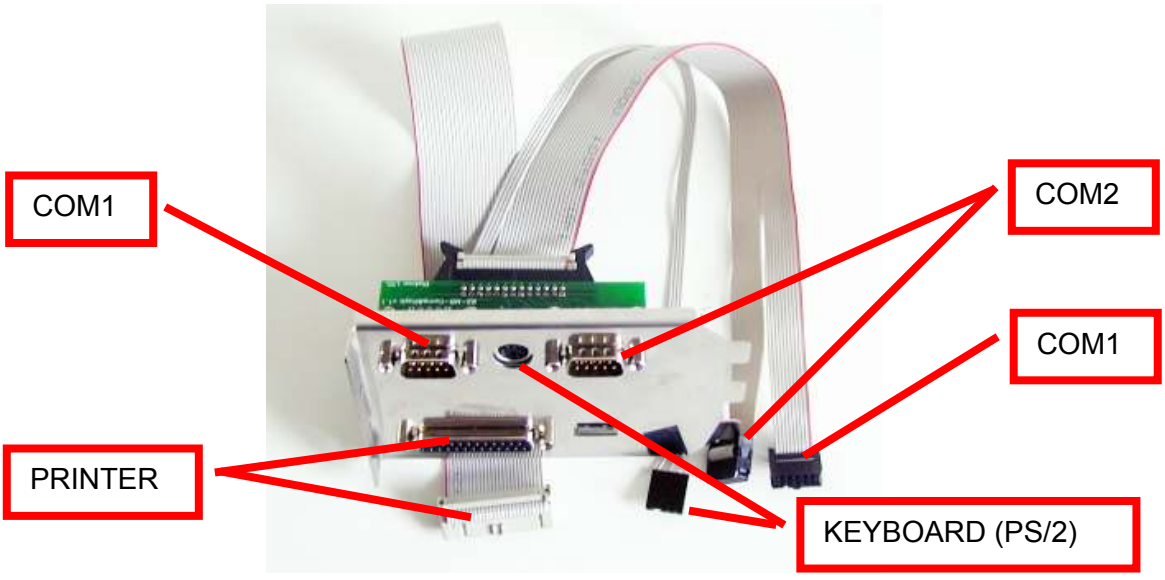


Figure 3. Peripheral connectors

MB4DIMM motherboard provides connection to the power supply, floppy drive, external peripherals, power switch, speaker, etc. (see Figure 4. for details).

On-board battery powers the real time clock of the Dimm-PC while turned off. The ISA slot is for the MPNIF board.

This board requires different mechanical plate, since mechanical measures are different, but it is electrically compatible to existing AT type motherboards.

Two LEDs are indicating state of power:

1. Green LED is on, if external power is present (stand-by mode), while
2. Yellow LED is on, if power is turned on.

Please, remove external power, or turn off power switch on the power supply if you remove or replace components (e.g. DIMM-PC, MPNIF, MB4DIMM).

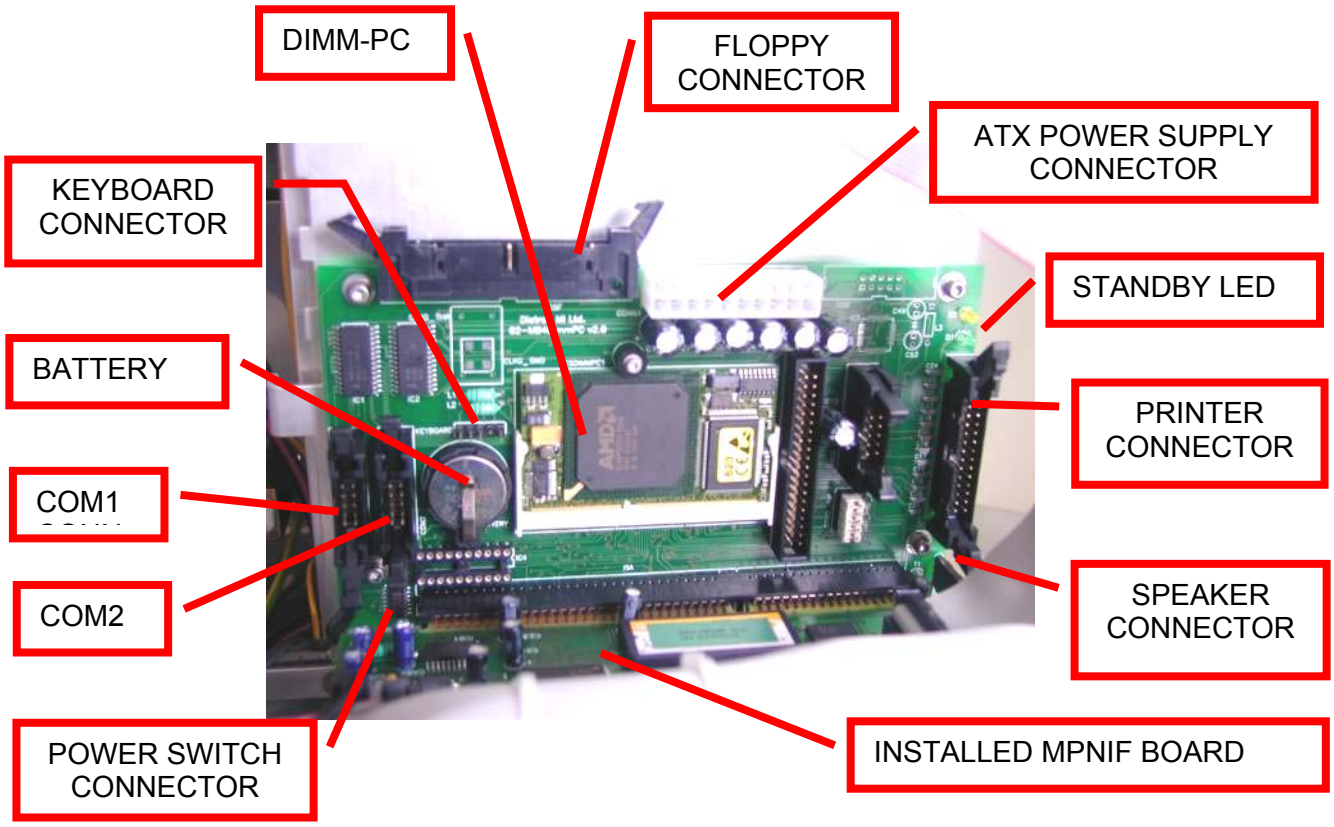


Figure 4. MB4DIMM motherboard

Major differences from AT type main boards:

- PS/2 keyboard connector
- Pentium 100 MHz processing performance
- Safe keeping of CMOS settings (EEPROM)
- Floppy is generally drive A: (there is no need to Swap floppy drives in BIOS). If you boot from MS-DOS floppy, type B:<enter> before proceeding with upgrade to make floppy B:
- Upgrade from existing main boards requires SW upgrade as well. In this case Software is stored on the MPNIF board (depending on the BIOS settings, see Addendum 2.).
- New analyzers have no Disk-on-chip on MPNIF, so operating software runs from SanDisk of DIMM-PC.
- Disk-on-chip of some older cards can slow down initialization, since it can interfere with SanDisk. The solution is to boot from a floppy, and format SanDisk to hold no operating system and/or boot code at all, and then disable SanDisk in BIOS.

2. This section is an addendum to Service Manual Section 6.4

Key settings of DIMM PC CMOS

MDA emulation mode was developed to help the manufacturer and Service Personnel in checking the instrument. This mode is available during the total operation but especially useful for checking BIOS setup and OS functions.

MDA operation is the same as it was with old main boards.

General Information

To start the setup utility, keep repeatedly pressing the <F2> key during startup. The start of the Setup program is indicated by the keyboard status LED's coming on and off, then only NumLock remains on. Additional beeps (when <F2> is pressed) indicate running of the Setup program.

Now, use the **?** and **. (dot)** keys on the instrument keypad to enter MDA mode, to see computer display on LCD. With MDA mode, you get the normal PC screen displayed on the LCD. As the LCD is smaller than the screen, only a part (one quarter) of the screen is shown. You can move this display window of the screen using the arrows on the keypad.

To select an item, simply use the arrow key to move the cursor to the field you want. Then use the plus and minus keys to select a value for that field. The Save Value commands in the Exit Menu save the values currently displayed in all the menus.

To display a sub menu, use the arrow keys to move the cursor to the sub menu you want. Then press <Enter>. A pointer marks all sub menus.

Important settings for the CMOS to use MPNIF with DIMM PC

Main menu

Legacy Diskette	**1.44/1.25 MB, 3 ½ "**
Primary Master	**AUTO**
Primary Slave	**AUTO**

The Advanced Menu

Reset Configuration Data	**No**
Halt On Errors	**No**
CPU Speed	**133 MHz**
ISA bus cycle duration:	**800 ns**
I/O Device Configuration submenu:	
Local Bus IDE Adapter	**Enabled**
Floppy disk controller	**Enabled**
Base I/O address	**Primary**
Serial port A	**3F8h, IRQ4**
Serial port B	**2F8h, IRQ3**
Parallel Port	**Enabled, EPP, 378h**

Setup Boot Menu

Floppy Check	**Disabled**
Summary Screen	**Disabled**
QuickBoot Mode	**Enabled**
Dark Boot	**Disabled**

Boot Device Priority submenu:

- + Hard Drive
  - Add-on cards
  - SanDisk
  - Primary Slave
- + Removable Devices
  - Legacy floppy drives
- CD ROM
- Network Boot

Exit Menu

Exit Saving Changes
Saves all the selections and exits setup. The next time you boot, the BIOS configures the system according to the Setup selection stored in CMOS.

Exit Discarding Changes
Use this option to exit Setup without storing in CMOS any new selections you may have made. The selections previously in effect remain in effect.

Load Setup Defaults
Select to display the default values for all the Setup menus.

Discard Changes
If, during a Setup session, you change your mind about changes you have made and have not yet saved the values to CMOS, you can restore the values you previously saved to CMOS.

Save Changes
Saves all the selection without exiting Setup. You can return to the other menus if you want to review and change your selection.

Would you make a mistake, or get lost among settings, you can restore defaults anytime, by selecting “Load Setup Defaults” and starting all over again.

* * *

New spare parts for the new motherboard can be found in paragraph 8.

Revision History

Rev. No.	Date	Person	Related section	Description
V2.1b	2001.04. 06.	A. Gyetvai	9.2	Serial Protocol example fixed
V2.1c	2001.04.23.	B. Mendele	2.2.4; 6.8; 7.1.2; 7.2.4	New pump type included
V2.1d	2001.07.16	A. Gyetvai	8.	Sxxx code parts revised
V2.2	2001.09.06.	C.Magyar	5.2.6	Service menu updated
2.3	2002.01.08.	C.Magyar	5.2	Service menu upgraded, editable
2.4	2003.06.10.	I. Losonczi	8.0 and new section 10.0	New spare parts and Addendum about new motherboard